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ALIEN PROPERTY CUSTODIAN

PROCESS FOR MAKING AN EMULSION FOR MORTAR TEMPERING

Carl Letters, Koln, Germany; vested in the Alien Property Custodian

No Drawing. Application filed December 11, 1935

This invention relates to a process for the production of an emulsion for the purpose of tightening mortar. The invention has for its object to attain the known very good tightening effect of the lime soap formed in the mortar itself with the free lime in such a manner that the formation of the lime soap takes place in the finest possible distributed foam and so that thereby on the one hand a greatest possible protecting effect is obtained and on the other hand at the same time scum formation is practically absolutely prevented. This problem is solved according to the invention in that highly molecular fatty acids, or a mixture of the same, are emulsified in alkaline solution with saponifiable fats or oils with simultaneous employment of non-saponifiable oils and fatty substances in the presence of emulsifiers and preserving colloids, such as vegetable mucilages and vegetable gum, polymeric carbohydrates, albuminoid substances or degradation products of the same and sulfite spent liquor.

Herefrom results therefore that the tightening effect of the emulsion in reaction with the mortar is effected by the formation of lime-soaps in finest distribution, and that at the same time any formation of scum film which loosens the mortar structure and reduces the coherency is avoided. This is attained, according to the invention, in that:

1. A combined emulsifier and preserving colloid effect of an obviously chemically reacting mixture of sulfite spent liquor and albuminoid substances is employed, and

2. Not the highly molecular fatty acids alone but in mixture with non-saponifiable oils and fatty substances are employed.

It has not been known up to the present that the formation of most finely distributed lime-soaps in the mortar becomes possible thereby that highly dispersive fatty acids, which normally react with glue-water spontaneously with formation of coarse flakes, are introduced with the aid of such emulsifiers and preserving colloids. This is possible only by the property belonging to the emulsion, to contain free fatty acids besides alkali hydroxide without producing the typical alkali soap reactions. Evidently there is present in this instance a suspension colloid and not, as in the case of soaps, an emulsion colloid. During strong shaking no scum formation can be observed in the dilution 1:20 with water, in opposition to true soap solution of similar concentration, the scum bubbles which have formed decomposing instantaneously on standing, this being not the case with the soap solution. Further, the viscosity of the emulsion is very little compared with that of the soap solution, the values corresponding comparatively approximately to a 10% as compared with a 100% glycerine solution. For illustrating the highly dispersed lime-soap formation a comparison test may be cited as follows:

Every 5 grams of potash soap (8% oleatic acid) and 5 grams of the new emulsion (8% oleatic acid) have been dissolved filled up to 100 cubic centimetres with water. After addition of 10 grams of Portland cement every mixture has been strongly shaken 20 times in measuring cylinders and after standing during 15 minutes the sediment which had formed was read. This amounted for the soap solution to 40 cubic centimetres of granular, flaky parts, a portion of the cement forming a stiff mass with the scum on the top. In the emulsion the sediment amounted to 14 cubic centimetres of very fine particles, the solution standing above contained a turbid milk of some cement with emulsion particles. The scum above the liquid was decomposed. A comparison test without addition yielded a sediment of 12 cubic centimetres.

Herefrom results necessarily that in spite of the presence of free fatty acids besides free alkali in the emulsion the stability of the emulsion cannot be attained by means of soaps, but that as emulsifiers and preserving colloids the combination of sulfite spent liquid with the albuminoid substances is responsible. As thorough experiments have shown, it is not possible, to produce a useful, stabil emulsion with one of the components alone so that this combination is of quite special importance.

According to the known processes it is desirable to either add finest possible distributed lime-soaps to the mortar or to make them originate therefrom. This is, however, a difficult task on account of the extraordinarily great reaction capability of the lime-soaps. If the lime-soaps are added to the mortar in completely formed state, the fatty substances are bound either on lime or on clay and slate and absorbed. The particle size of such suspensions, which are mostly pasty, must in no case be less than 10, whereas that of clear emulsions is far below this. The new emulsion therefore gives also, with any desired water dilution, clear or only weakly turbid stable solutions, whereas the suspensions form sediments rapidly. As the importance and preserving effect rapidly increase with the reduction of the particle size, this shows that a serious progress results from the invention.

That a fine dispersion is often desirable in

order to attain a more intensive effect, is generally known, however, the way leading to this aim proposed in the present process has nothing to do with the dispersion, for instance by a Planson colloid mill. At another place it is mentioned that the generally prejudicial, loosening effect of scumming colloid substances in the mortar (in this instance albumin degradation products) may be prevented by addition of little quantities of salts of higher fatty acids of sulfuration products from the same. Comparatively large quantities of albuminoid substance with a little addition of scum preventing media are in question. The mortar tightening is in such cases not effected by lime-soaps as in the new emulsion, but it is based upon the tightening effect of albuminoid substances, which represent easily moistenable substances dissolved in water in more or less molecularly dispersed form.

The present invention relates, however, to a true emulsion which, for preventing scum formation, contains not only unsaponifiable oils and fatty substances, but also the combined albumin-sulfit spent liquor emulsifier, and the tightening effect of which in the mortar is based chiefly on the formation of water-repellent lime-soaps. In this instance the matter is to prevent scum formation on another object and by other means, and it is generally known that this problem has to be solved in a different manner for any manufacturing.

The progress which is attained according to the invention is clearly shown by the following association:—

Addition	Weight of the mortar per unit of volume	Mortar condition
Without addition	2.01	Permeable.
Addition according to the invention.	2.01	Well water-tight.
Insoluble soaps without soluble soaps.	2.01	Somewhat permeable.
Insoluble soaps with alkali soaps.	1.95	Satisfactorily water-tight reduced coherency.
Pure alkali soaps with and without soluble additions.	1.80-1.90	Satisfactorily water-tight strongly reduced coherency.

This result is, as already above explained, attained in that the fatty acid is mixed with unsaponifiable oils and fats (reduction of formation of scum film) and incidentally emulsified with preserving colloids, such as albumen, in combination with sulfite spent liquor in alkaline solution. Tests have shown that albumen products, as regards scum prevention are not sufficiently effective, that on the other hand the sulfite spent liquor, which has a specially good scum reducing effect, if employed alone, did not give a good emulsification and also not complete avoiding of scum formation. Herefor an addition of unsaponifiable fatty substances was also necessary.

It has further been ascertained that a stable emulsion had to be obtained in which free fatty acids could exist at the side of free alkali without forming a soap, this being recognized already from the low viscosity of the emulsion. This could be attained thereby that albumin as well as sulfite spent liquor are employed simultaneously, and a mixture of these substances in a condition as free from water as possible, with the fatty acids and unsaponifiable oils was boiled in the presence of potash lye and then prepared with water to form a liquid emulsion. It seems that then the sulfite spent liquor chemically reacts with the albumin, probably in such a manner that gluco-proteides are formed. In any case the xanthoprotein reaction and also other albumin reactions no longer pass off distinctively positive. It would be very difficult to give here more detailed statements about the chemical process. Apparently the lignine sulphonic salt is especially effective in the sulfite spent liquor for preventing the scum formation, whereas the carbohydrates which are present effect the finer distribution of the tightening medium.

According to the invention such an emulsion can be prepared in that highly molecular fatty acids, saponifiable fats and oils in mixture with unsaponifiable oils and fatty substances, with employment of emulsifiers or preserving colloids, such as vegetable mucilages and vegetable gum, polymeric carbohydrates, albuminoid substances, sulfite spent liquor are treated in alkaline solution to form a stable emulsion. For example 5 parts fatty acid in mixture with 6 parts mineral oil are emulsified with 89 parts of an aqueous solution of albuminoid substances and sulfite spent liquor with addition of alkali hydroxide. Highly dispersed liquid emulsions can be obtained by employment of liquid fatty acids and liquid mineral oils together with potash lye or pasty emulsions can be produced with solid fatty acids, such as stearic acid and solid hydrocarbons, such as paraffine.

The emulsions produced in this manner dissolve in the water either clear or with feeble turbidity. Added to the mortar tempering water in a quantity of about 2 grams for 100 grams cement, these emulsions make it possible to attain excellent tightening effects without impairing of the mortar quality, this being due to the fact that the active substances can be distributed in the mortar in highly dispersed state and that the formation of water-repellent lime-soaps owing to the preserving effect of the emulsifiers takes place without formation of scum film and in such finely distributed form that the utmost preserving effect is ensured. Another advantage of these emulsions is that they possess a high wetting effect and reduce the amount of water necessary for the mixing of the mortar, this being very important relative to the coherency of the mortar. The mortars prepared with the emulsion possess further increased elasticity and greater coherency, this promoting a uniform mortar mixture and preventing formation of the apprehended water-pores in the mortar. Metallic salts can also be added to the emulsion for attaining special effects.

CARL LETTERS.

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ALIEN PROPERTY CUSTODIAN

DISPENSING DEVICES

Karl Ludwig Schiff, Berlin, Germany; vested in the Alien Property Custodian

Application filed May 25, 1936

The invention relates to a device for holding paper rolls, leaf paper packages and other objects which are put as package or pile into a distributing or holding device and which are taken out singly the one after the other.

With such devices the person who has to attend to the insertion of a new roll or the like can mostly not be present just then, when the last leaf or the like has been taken out. It is therefore often usual to deposit in the proximity a spare roll or the like. The beginning of the use of the spare roll or the like takes often place without inserting it into the holder. The consequence is that the new roll lies often about on the floor, is soiled, and that much material is wasted. Finally, the taking out of paper from a roll or the like not put into the holder is inconvenient. In penny-in-the-slot devices it is not possible at all to lay at hand a spare filling.

The described disadvantages are removed according to the invention thereby that at the same place of use two holders each with one roll or the like are provided in such a manner that after the depletion of the one holder the distribution takes place from the other holder. Suitably the two holders are combined into one device and always only the distribution from the one holder is free until its depletion.

Further features of the invention can be gathered from the embodiments shown schematically in the drawing and from their following description.

In the embodiment of the invention according to Fig. 1, two paper rolls **11**, **12** are supported from a base plate **10** by means of usual bows **13**, **14** or the like. On a rod **15** or the like supported by the base plate **10** a covering shield **16** is reciprocably movable. The shield in its position shown in the drawing prevents a withdrawal from the roll **12** and protects the same against soiling.

After depletion of the roll **11** the shield **16** is moved on the rod **15** so that now the roll **12** lies free for the withdrawal of paper. Occasionally before exhausting the roll **12** a new roll is put into the holding yoke **13** instead of the roll **11**. It is then the turn of the new roll after the depletion of the roll **12**.

In the embodiment according to Fig. 2 a box **20** is subdivided by an intermediate wall **21** into two compartments each provided with one dispensing opening. In each of these compartments, one of the usual packages of interleaved sheets may be inserted. The one of the two withdrawal openings **22** or **23** respectively is for the time being closed by a plate **25** slidable in guides **24** of the box **20** and provided with a handle **26**. For the insertion of spare packages the box **20** is detachable from its rear wall or to be turned off or in another manner to be opened. Besides the use of this device corresponds to the use of the device according to Fig. 1.

Fig. 3 shows perspectively and Fig. 4 shows in front view still more reduced in scale a further embodiment of the invention. Two rolls **30**, **31** are mounted the one above the other by holders **32** and **33** respectively on a base plate **34**. The plate **34** on its turn is connected with a base plate **36** for instance by a pivot **35** and rotatable with respect to the latter around an axis perpendicular to the plane of both plates. A box **37** open below and rearwardly is journaled above to the base plate by a hinge **38**. In the downwardly turned position the box **37** covers the upper roll **31** and lies with its side walls against the side margins of the turn plate **34** in such a manner that the latter is blocked up in its position.

If after exhausting the roll **30** the roll **31** shall be taken into use, then the box **37** is turned upwardly and the plate **34** rotated so that the roll **31** is now below, the box **37** is then lowered again and thereby the plate **34** secured in its new position. Also here, the empty holder **32** being under the box **37** is occasionally provided with a new roll.

The probably best solution principle for paper rolls and paper packages too is the basis of the embodiment which is shown in Fig. 5 perspectively and in Fig. 6 as lateral sectional view in a more reduced scale.

Two rolls **41**, **42** are situated parallel to each other in a, preferably casing-like, body **40**. The body **40** on its turn is mounted rotatably around a horizontal axis **44** parallel to the axis of the rolls in the side parts of the body. Finally the body **43** is journaled to a base plate **46** by hinges **45** the axis of which being parallel to the axis **44**. If now the upper roll, covered by the walls of the bodies **40**, **43** shall be taken into use, then by gripping into the hand opening **47** the body **40** together with the body **43** is swung forwardly around the hinges **47** and thereupon the roll-body **40** together with the rolls **41**, **42** is rotated alone around the axis **44** until the roll **42** is below. After releasing, the parts rest anew against the plate **46**.

By the box-like formation of the roll support **40** and the hanging body **43** the upper roll is always completely covered and the lower roll too

projects only from the body **40** to that extent necessary for the withdrawal of the paper.

Apart from the shown embodiments numerous further realisations of the invention are possible. Especially details of the shown embodiments are modifiable. In the embodiment according to Fig. 2 for instance, the compartments may be arranged side by side and then the withdrawal openings may eventually be provided in the bottom wall of the box. In the embodiment according to Fig. 3 for instance, the pivot **35** fixed to the one of the plates may pass through a slot perpendicular to the roll axis so that always in the terminal position the centre of the roll plate **34** lies below the pivot of rotation and the plate is always in a stable position.

In the solutions shown in Figs. 5 and 6, links (or a bow) which are in a corresponding way journaled to the base plate **46** and the roll support **40**, may for instance substitute the hanging body **43**. Furthermore an intermediate hanging structure may be dispensed with, if the device is modified as intimated in Fig. 7. Here the pivots of rotation **44** of the roll body **40** engage inclined slot guides **48** of arms or casing walls **43** fixed to the base plate **46**. The inclined slots may of course be provided in the roll-body and the pivots on the arms of the base plate. There has only always to be preserved the principle that the roll-body and its axis of rotation can be brought into a distance from the base plate allowing the rotation.

For the new device it is important that always rolls of proper size and in the position desirable for the withdrawal of the paper are put into the holder; the latter demand is especially easily not corresponded for devices with a movable roll support, as in these the holder is mostly not in position of withdrawal when the roll is put in. These circumstances are according to the invention taken into account by such a formation of the connecting means between holder and roll that only the mounting of a roll being intended for the holder in question and in the desired position is possible.

Fig. 8 shows an embodiment of this feature by a longitudinal section through a roll core and the holder parts seizing it. From pieces **51**, **52** suitably pressed from sheet metal, card board, artificial resin or the like or for instance turned out of wood are slid into and fastened in the end openings of a mill board tube **50** wound around inn the usual way by paper. The one form piece shows an annular groove **53** which is engaged by an annular projection **54** of the one elastic holding arm **55**. For taking up the axial pressure the middle of the form piece and a part of the holding arm may be brought into contact as shown. The other form piece **52** has a central cylindrical opening or recess **56** which receives a pivot-formed projection **57** of the second holding arm **58** which is eventually elastic in the same manner.

With the described formation of the holders only rolls with correspondingly prepared core can be mounted in a determined position. The form pieces reinforce the mill board tube **50** so that it may be chosen thinner, if one does not prefer to provide a monopiece core for instance turned out of wood and having corresponding endfaces.

In the walls of the covering boxes, shields, compartments or the like, sight openings or windows are suitably provided, so that the depletion of one holder or compartment is easily to be noticed and a spare filling is taken care for in due time.

The invention is not limited to any specific manner for holding or guiding the rolls, leaf paper packages or any specific means for encasing the same. The invention is furthermore not limited to any specific form of paper stocks, as for instance rolls or leaf paper packages. In the appended claims the expression "holding means" is intended to cover any possible manner for holding or guiding the paper stocks and the expression "paper stock" is intended to comprise every possible form of paper rolls and paper packages.

KARL LUDWIG SCHIFF.

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Fig. 1

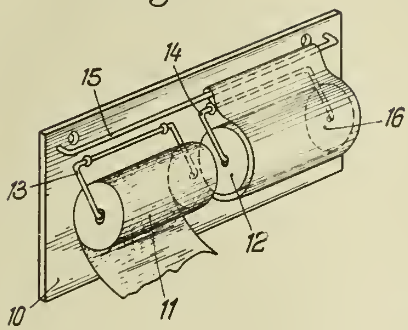

Fig. 2

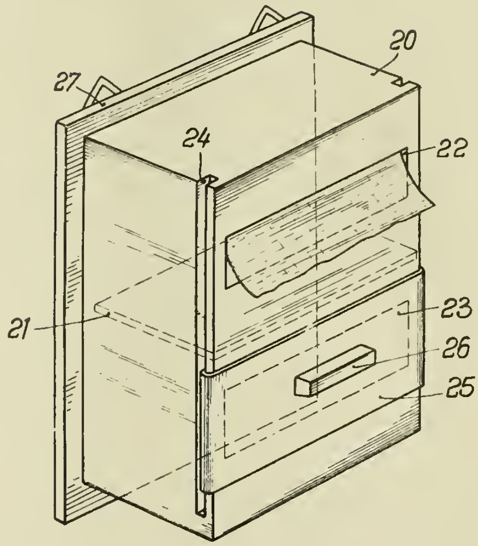

Fig. 3

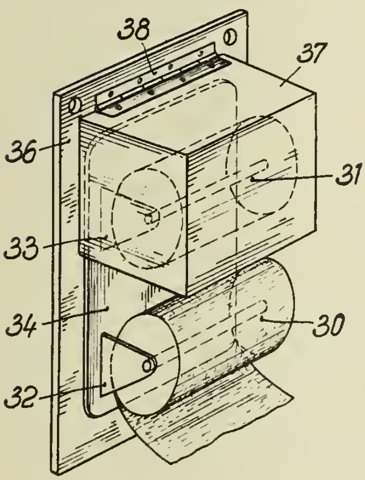

Fig. 4

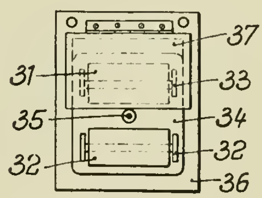

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Fig. 5

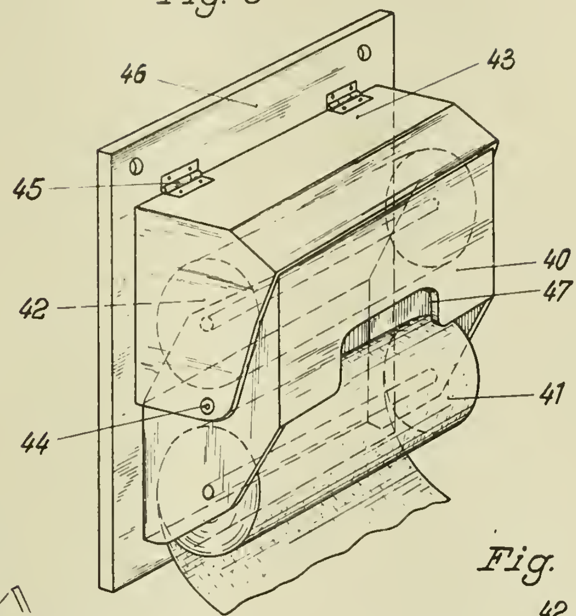


Fig. 6

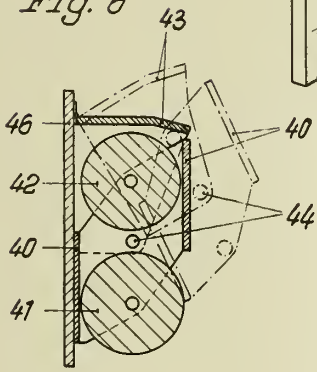


Fig. 7

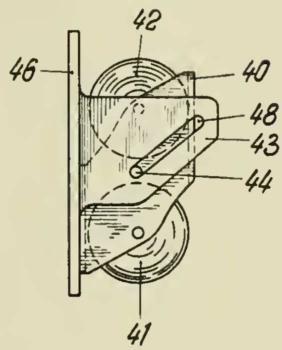
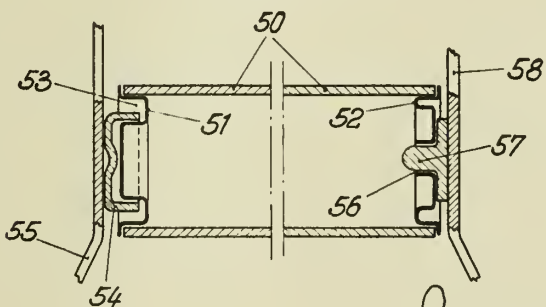


Fig. 8



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ALIEN PROPERTY CUSTODIAN

AUTOMATIC SELECTIVITY CONTROL FOR RADIO RECEIVERS

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Application filed June 13, 1936

The present invention applies to radio and like modulated carrier wave receivers and relates more particularly to arrangements for automatically controlling the response of such receivers to the modulation frequencies in view of giving under the particular local reception conditions the best possible degree of fidelity compatible with a sufficient freedom of background noises.

It is highly desirable that such a receiver should be substantially free from so-called "amplitude" or "linear" distortions. It is also well known that most stations cannot be received with a perfectly faithful reproduction since the interferences caused by the modulation of one or more stations operating on adjacent frequencies would be exaggerated. Another form of interferences, the so-called "static" caused by man-made interferences, or atmospherics, also gives frequently an unpleasant background when receiving comparatively weak stations. All these interferences are reduced to a reasonable degree when the width of the modulation band correctly transmitted by the receiver is restricted. This restriction is usually carried out in the carrier frequency section of the receiver by increasing the degree of selectivity, and in addition thereto in many instances also in the audio portion of the receiver amplifier. Since this restriction of the band width impairs the quality of reproduction it is important that it shall be carried out to the strictly necessary degree only and a judicious compromise is therefor necessary in this matter. The terms fidelity, or quality will be used hereinafter to indicate that condition of the receiver which is opposite to the sharply selective state, whether this condition be obtained by broadening the carrier frequency response of the receiver only, or by conjointly extending the audio response of the audio frequency portion of the receiver towards the treble. With most receivers the care of so adjusting the means for increasing the fidelity as to give the best possible compromise between fidelity and absence of interferences is leaved to the operator.

Since the required degree of adjustment varies from one station to another this places a considerable hardship on the user of the receiver and it also requires an appreciable degree of experience and furthermore the degree which has been adjusted does not remain correct due to causes such as fading both of the desired station and of the interferences.

It is known to provide a radio receiver with automatically actuated fidelity regulation means operating in dependence on the strength of the desired carrier wave. The disadvantage of this system is that in most cases the degree of selectivity is not set correctly since the device takes not into account the value of the interference level, so that in many instances serious interferences are experienced especially when a rather strong transmitter is neighboured by a stronger one. For this reason a manual control in addition to the automatic one, is practically indispensible with the said device.

My invention is clearly distinguished from these prior devices and it overcomes the disadvantages just mentioned.

The main object of my invention is to provide a receiver wherein the degree of fidelity is controlled directly in dependence on the strength on the desired carrier wave and inversely in proportion to the strength of the interfering waves.

My invention applies more particularly to those interfering waves which are set up by stations having a small frequency spacing from the desired transmitter since these are usually the most unpleasant. It will however be shown that it is also very suitable for minimising the noises caused by so-called static and when hereinafter reference will be made to an interfering wave or carrier it will be understood that this latter kind of interfering wave is not excluded.

If in a receiver in accordance with my invention the strength of the carrier which it is desired to receive grows stronger whilst the interference level remains the same the degree of fidelity will increase. It will decrease however and the degree of selectivity will increase concomitantly when the strength of the wanted carrier increases and the interference level is increased in a larger proportion. Although it would theoretically be best to control the degree of fidelity exactly in accordance with the ratio of the wanted to the interfering field strengths, it is obvious that such a high degree of precision is by no means required in actual practice, it being all the same easy to obtain even better results than when the receiver fidelity would be adjusted continuously by a skilled operator. Since it is also possible to express the ratio just mentioned by the difference in decibels between the level of the interferences and of the wanted carrier intensity respectively I have termed my invention automatic "differential" selectivity control, and I have for the purpose of simplifying the description thereof used the abbreviation "A. D. S." particularly when designating control tensions produced in accordance therewith.

An important feature of my invention is to

provide in a tunable radio receiver an auxiliary control channel which responds efficiently to the interfering waves, more particularly to the interfering carriers, and which responds to a comparatively small degree to the desired carrier, and this channel embodying a rectifier associated with suitable amplifier means, the D. C. output serving to control an essential part of the fidelity regulating means of the receiver.

According to another feature of the invention the transmission efficiency of the said auxiliary control amplifier and/or of an amplifier section of the receiver which feeds the said channel is modified inversely in accordance with the strength of the desired carrier, these means being preferably the same as or associated closely with, the overall gain control device which is usually incorporated in the receiver.

In a preferred form of carrying out the invention, a single set of tensions derived from the said control channel, or a plurality of sets of tensions which are closely related, serve to control the predominant part, or the whole, of the fidelity control means of the receiver.

These tensions preferably represent the ratios of the wanted to the interfering fieldstrengths on an efficiently compressed scale, since the range of these ratios at the input of the receiver is extremely large and would otherwise be likely to cause overload of the control channel or of the regulated means. My invention provides different manners for carrying out this compression, the main forms profiting by the reduction of the efficiency with which the interfering waves are transmitted by a selectivity-controlled receiver section which is common to the receiver proper and to the control channel, or alternatively, or conjointly, modifying the gain of the control channel inversely in dependence on the strength of the tensions across the rectifier of the said channel.

My invention also provides different classes of filter circuits for giving the required response to the interfering waves, with the substantial exclusion of the wanted carrier. One of these classes uses selective circuits which are common up to an important degree to the receiver channel proper and to the selectivity control channel, there being chiefly added means for substantially attenuating, or removing, the wanted carrier. Another class uses for the auxiliary control channel circuits which are approximately tuned on the frequencies where the interfering carriers are most likely to operate.

A subsidiary object of my invention is to provide means for rendering visual the operation of the selectivity control device so as to allow an appreciation of the quality with which a station may be received, this device being fed by the same tensions as the selectivity control or by means closely associated therewith. A modified form of this feature gives at the same time indications on the degree with which the receiver is in tune with the carrier.

For a more complete understanding of my invention, reference should be had to the accompanying drawings of which:

Fig. 1 is an electrical diagram of one arrangement in accordance with the invention; Figs. 2–5 are graphs illustrating the operation of the arrangement shown in Fig. 1; Fig. 6 is a graph illustrating the operation of some other forms of the invention, these forms being further illustrated by Figs. 3–11; Fig. 12 is a graph illustrating the operation of a feature shown on Fig. 11, whilst Fig. 13 shows still another arrangement in accordance with my invention.

Referring to Fig. 1 a radio receiving system comprises a signal collecting means 1 and ground 2, the energy set up therebetween being transferred through the coupling coil 3 to the circuit 4 which is tuned upon the frequency of the wanted signals and shunted across the input electrodes of the amplifier tube 5. This tube is preferably of the screened pentode type comprising in addition to the main control grid 6 a suppressor grid 7 brought out to a separate terminal; by a suitable dimensioning of the electrodes of this tube it is possible to vary its internal resistance by controlling the negative bias of the suppressor grid, without there being too pronounced a degree of variation of the mutual conductance of the tube, the resistance thereof increasing when the negative bias is increased. The connections of the screen grid of the tube and of the heater element thereof (it being preferably of the equipotential-cathode type) have not been represented, nor have they for the other tubes of the receiver system, in view of simplifying the drawings. The valve 7 includes in its anode circuit a transformer comprising a primary aperiodic coil 8 connected to the sources of high tension supply +HT and very tightly coupled to the tuned secondary 9 which is tuned upon the wanted signals and connected to a suitable frequency changing device of any well known kind and which has been represented as comprising a modulator MOD cooperating with a local oscillator OSC tunable by means of the circuit LO, this circuit bearing a constant frequency difference equal to the intermediate frequency with respect with the signal frequency. As is common use in modern receivers, the tunable circuits 4, 9 and 10 are ganged and operable by a common tuning control. The output of the frequency changing device includes a circuit 11 tuned to the operating intermediate frequency and coupled, as by mutual inductance to the circuit 12 which is also tuned to this frequency and connected to the input electrodes of the tube IF1. This tube is of the triode type and has a low internal resistance and a so-called variable mutual conductance characteristic. The anode circuit of this tube includes a resistance 13 connected to the source of positive potential, the energy at intermediate frequency set up across this resistance being applied through the condenser 16 to the amplifier tube IF2 which is thus connected in cascade with IF1, and part of the energy disponible across the resistance 13 being also fed back to the circuit 12 through the condenser 14 and the coil 15, this latter coupled with the circuit 12. By varying the amplification given by the tube IF1, by means of a control of its negative grid bias, it is thus possible to lower the decrement of its grid circuit to variable degree. The tube IF2 is preferably of the screen-grid type and its anode circuit comprises a band pass filter consisting of the two tuned circuits 18 and 19 coupled as by mutual inductance; undesired interactions between the circuits 11, 12 and 18, 19 are avoided by the interposition of the tube IF1 which therefor acts also as a so-called buffer valve. The degree of damping of the circuits 18 and 19 may be varied by including them in the anode circuits of the auxiliary tubes A1 and A2, of the triode type. The grid bias of these tubes is variable and their anode-cathode paths act therefor as variable resistances in shunt across the associated circuits and damping them to a variable degree. The cir-

cuit 19 is connected to the input electrodes of the tube IF3 the anode circuit of which includes a resonant circuit 20 having one side connected to the high tension supply, the said circuit being tuned to the intermediate frequency.

The circuit 20 is coupled as by mutual inductance to a similar tuned circuit 21 which is connected to the input electrodes of the demodulating rectifier 22, of the diode type. The modulation frequencies thus obtained are fed to the first low frequency amplifier tube 24 through a condenser, and a filtering device 23 for removing the high frequency components. The tube 24 is of the triode type and has a characteristic of the variable mutual conductance type and its anode circuit includes a resonant circuit tuned to a frequency near the top of the modulation band which it is desired that the receiver shall reproduce correctly, say 7000–8000 c/s, the said resonant circuit comprising a coil 26 and a condenser 25 and being connected in series with a resistance 27 of low value, say 5000 ohms.

One side of this resistance is also connected to the high tension supply. The voltage set up across the network 25—26—27 is transfered to a further low frequency amplifier section LF and actuates a reproducer R.

Signal energy at intermediate frequency is also fed to a screen grid tube V1 comprising an anode impedance 29 such as a circuit tuned to the intermediate frequency, the voltage set up across this circuit being applied to a rectifier VR, such as a diode. The direct current tensions set up across the rectifier resistance 30 after having been filtered by means of the resistance-capacity filter 31, and which tensions vary in accordance with the field strength of the desired station, are applied to the amplifier tubes 5, IF2 and IF3 through the line marked A. V. C., this automatic sensitivity control arrangement being quite conventional and maintaining approximately constant the output across the rectifier VR and hence also across the demodulator 22 and the tuned circuit 20.

A further part of the energy of intermediate frequency set up across the circuit 20 is fed to a screen grid tube S1 through the condenser 32 of very low value, the input electrodes of this tube S1 being bridged by a network 33 comprising the resonance circuit 34 which is comparatively damped and tuned to the nominal intermediate frequency, and which is shunted by the quartz crystal 35, the natural frequency of which is that of the nominal intermediate frequency. This crystal acts as a series resonance circuit and offers a very low resistance path to the nominal intermediate frequency so that this latter is substantially by-passed, whilst for frequencies slightly spaced from the exact intermediate frequency the impedance of the crystal (and also that of the damped resonant circuit 34) is considerable, so that the resultant resonance curve of the network 33 presents a mediate crevasse typical for the quartz filter. The high frequency energy applied to the tube S1 appears amplified across the anode resistance 36 and is transferred to a further amplifier tube S2 the anode circuit of which includes a coupling network indicated by the general reference 37 and comprising a parallel resonant circuit 38 shunted by a series resonant circuit 39 both these circuits tuned upon the nominal intermediate frequency. This network gives a substantial response at frequencies spaced by some 10 kc. from the operating intermediate frequency where the interfering carries are most likely to operate (the circuit 38 being preferably rather damped, for this purpose); for the desired carrier frequency on the other hand the impedance of the network is less high, its response curve being double-humped with a marked depression between the two peaks.

The high frequency energy set up across the network 37 is applied to the rectifier SR which is of the diode type, the top of the network being connected through the condenser 40 to the anode of the diode, the current flowing by reason of the unilateral conductivity through the rectifier resistances 41 and 42 and setting up tensions there across, the resistance 41 being connected to the anode and the other 42 to the cathode of the diode SR, the two other ends being connected together and to a source of negative potential with respect to the ground. Thus when no appreciable high frequency voltage is applied, both its anode and cathode assume substantially with respect to ground the potential of this negative source of current whereas if high frequency signals are impressed to the diode, the potential of the diode anode further falls with respect to ground whilst that of the cathode rises and tends to attain, and even to depass the ground potential. The DC tensions led of at the diode anode are cleared from their high frequency and low frequency components by means of the resistance-capacity filter 45, 46 and they are applied through the line A. D. S. to the grids of the auxiliary tubes A1 and A2. The time constant of the filter may vary between fairly large limits and be equal to, say ⅕ sec.; it may be useful to make it somewhat larger than the time constant of the gain control device which is usually about $^1/_{15}$ sec. The cathode of the tubes A1, A2 is normally at a negative potential with respect to ground, of such value that in the absence of signals applied to the rectifier SR their cathode is at a small relative positive potential of say 3 volts with respect to the line A. D. S. Under these conditions the internal resistance of the tubes A1, A2 is rather small in comparison to the impedance of the associated tuned circuits 18, 19 which then are efficiently damped. However, when the potential of the line A. D. S. falls, due to the high frequency signals applied to the rectifier SR, the increasing negative bias of the tubes A1, A2 towards their cut off point causes their internal resistance to be increased, so that the damping of the associated circuits is progressively reduced.

The DC tensions at the cathode of the diode SR are similarly filtered by means of the resistance 44 and capacity 43, and are then applied through the line marked 2 A. D. S. to the suppressor grid of the radio frequency amplifier tube 5, to the control grid of the intermediate frequency amplifier tube IF1 and to the control grid of the low frequency amplifier tube 24. The cathode potential of these tubes is slightly positive with respect to ground, so that in the absence of signals applied to the rectifier SR these various controlled grids assume fairly large negative potentials with respect to their cathodes. Under these conditions, the internal resistance of the tube 7 is rather low, the tuned anode circuit 9 (through the transformer winding 8) being thus rather damped and passing a wide band of frequencies; the tube IF1 secures by small amplification, so that no appreciable feedback occurs to the tuned circuit 12 which normally due to a rather high decrement passes also a large frequency band. Under the same conditions the tube 24 of the variable mu type as was

already mentioned has a high internal anode-cathode resistance, and the associated tuned circuit in its anode path shows marked selective properties and offers a considerable impedance to the upper band of the modulation frequencies which thus are emphasized with respect to the medium and low modulation frequencies, thus offsetting the loss which they encountered in some of the more selective circuits of the intermediate frequency amplifier. These various actions are therefor cumulative and place the receiver in a condition of greatest fidelity. If large frequency tensions are however applied to the rectifier SR, the diode cathode potential rises and also the potential of the line **2** A. D. S. thus reducing the negative bias of the associated valve grids. The internal resistance of the tube **5** is thereby increased and the original selectivity restored to the tuned circuit **9**; the resonance curve of the filter **11—12** is sharpened as the feed back increases due to the increasing amplification of the tube IF**1**; the internal resistance of the tube **24** decreases and the resonance properties of the circuit **25—26** are no longer very marked, so that the various modulation frequencies are amplified to comparable degree due mainly to the resistance **27**. It will be understood that the cutoff of other biases of these various tubes are suitably chosen so as to prevent for instance the grids of the tubes **7** and LF**1** from reaching positive potentials, or the grids bias of the tube **24** from varying in so wide limits as to cause an appreciable output variation; part of the rectified tensions only might be applied thereto as well.

The effect of the regulation of the frequency response of the receiver section following the branch off point **20** will not be considered at first, when I shall now proceed to the explanation of the operation of the device, nor will be made reference to the interferences caused by a regular background noise.

It will be seen that I have provided a receiver system comprising a first amplifier section which extends up to the branch off point **20** and includes the major part of the fidelity and selectively control means of the receiver, this section passing a band of frequencies including the wanted carrier frequency (i. e. the nominal intermediate frequency), the modulation side bands of this carrier, and also up to an appreciable degree the interfering carriers and their modulation. In cascade with this first section is another "receiver" section feeding an utilisation device which reproduces the wanted modulation and also up to a certain extent the interfering modulation. In cascade with the first receiver section and in parallel with the receiver section just mentioned is another amplifier channel which roughly passes the same frequency band as this latter section, with the exception however of a narrow band of frequencies including the "wanted" carrier, the frequency response for the interfering carriers being approximately the same as in the second receiver section. The rectifier of this channel therefor provides DC tensions which depend on the strength of the interfering carriers.

A good reproduction requires that the interfering modulation shall not disturb too strongly the wanted modulation, and since the interfering modulation is accompanied by correspondingly strong interfering carriers (the variations of the modulation depths being usually comparatively small and therefor susceptible of being neglected), the strength of the interfering carriers across the rectifier of the auxiliary amplifier section may serve to measure the degree of noise caused by the interfering modulation.

It is of course not the absolute strength of the interference on which depends the noise caused thereby, but its value relative to the strength of the wanted station, and this result is attained since the degree of transmission of the receiver section up to the point **20** was subject to an efficient overall gain control operating inversely in accordance with the field strength of the wanted carrier.

The tensions rectified by the auxiliary channel rectifier so actuate the selectivity control means of the first receiver section that the degree of transmission of the interferences in this first section remains sufficiently low, primary across the auxiliary rectifier, and as a consequence also across the reproducer, there being realized what may be termed a true control cycle.

This state of matters is further explained in connection with Figs. 2*a* to 2*d* of the drawings. Fig. 2*a* shows the distribution of the carriers at the reception point, the field-strength intensities being indicated vertically and the frequencies of the different carriers which are to be taken into consideration being indicated horizontally, the frequency of the "wanted" transmitter *a* being taken as a point of reference and marked zero (this being the nominal intermediate frequency) whilst the frequency of the interfering carriers b, b_1, b_2, . . . b_3 which extend on both sides of the wanted one are marked —10, —20 . . ., +10, +20 . . . (kc/s).

On Fig. 2*a* which bears indications similar to those of Fig. 1*a*, it is assumed that the action of the automatic gain control device of the receiver has been "complete" i. e. that the over all transmission efficiency of the receiver amplifier up to the point **20** has been adjusted exactly inversely in accordance with the field strength of the wanted carrier, and when it is supposed an instant that the wanted carrier has not been removed from the tensions reaching the rectifier SR (this being of course a mere speculation) the wanted carrier would be applied to this rectifier with a predeterminated amplitude a' whichever may be its actual field strength; all the other carriers set up tensions in accordance with the ratio a'/a this applying of course only if the selection power of the receiver is not taken into consideration.

In fact the amplifier has such a selectivity characteristic as to attenuate the interfering carriers to a degree dependent on their frequency spacing from the wanted carrier, this response at a particular instant being represented by Fig. 2c, where the frequencies are indicated horizontally, as previously, whilst the relative (percentual) gain of the receiver is indicated vertically. As was indicated previously it may be assumed for the purpose of simplifying the explanation that the relative response is the same as in the second "receiver" section and in the auxiliary amplifier section, except for the frequencies in the immediate neighbourhood of the wanted carrier, this being of no importance as far as the interfering carriers are concerned.

It may be assumed that the wanted signals will not be too strongly interfered if the condition of a ratio

$$\frac{\text{interfering carrier strength}}{\text{wanted carrier strength}}$$

of not more than some 1:320 is fulfilled in the receiver and the control channels. This ratio is completely determinated if that carrier which interfers most has a predeterminated value, this carrier being $b''3$, in the example shown and is represented on Fig. 2*d*; it corresponds to the carrier *b*3, Fig. 2*a* and is usually one of the transmitters distanced by some 10 kc from the desired one. The strength of this carrier as applied to the rectifier SR varies in direct proportion to the field strength of the interfering carrier and to the relative (percentual) gain of the receiver so that when this latter is suitably regulated any relative or absolute interfering field strength value may be compensated so as to let it substantially assume the predeterminated value $b''3$, or remain inferior thereto.

It will be at first supposed that the receiver is tuned to a strong carrier, and that the interfering carriers are very weak or absent. The action of the A. V. C. consists in placing the receiver under reduced sensitivity conditions, the interferences reaching the rectifier SR being thus very reduced too, so that there is no appreciable A. D. S. tension capable of displacing the receiver out of its position of minimum selectivity, this being its normal position. This condition is represented by curve c_1 of Fig. 3*a* where the frequencies are indicated horizontally and the relative gain vertically.

It will now be supposed that, whilst the wanted carrier (and thus the receiver sensibility) remains at its primitive value, an interfering carrier increases considerably its intensity. The A. D. S. tension (proportionate to $b''3$, Fig. 2*d*) tends to increase in the same proportion and is applied through the lines A. D. S. and 2 A. D. S. to the selectivity regulation means which cause a sharpening of the receiver resonance curve. This increase of selectivity opposes itself to an increase of the tension applied to and rectified by SR and if the device is sensible, the increase may remain very weak, having the tendency to remain naught, but in reality it must keep a given value, whatever small it be, to be capable of exercising the necessary action.

Now suppose that, whilst the interfering carrier continues to set up a comparatively high field strength, the field produced by the wanted station falls to a much lower value. The A. V. C. device increases considerably the sensibility of the receiver and thereby the tension applied to the rectifier SR increases considerably. This has for effect an appreciable increase of the A. D. S. tensions which tend therefor to increase considerably the degree of selectivity and this again tends to prevent the increase of the tensions across the rectifier SR, there being soon attained a position of equilibrium corresponding to a moderate increase of tension across SR, the degree of selectivity being represented by curve c_2 of Fig. 3*b* which bears indications similar to those of Fig. 3*a*.

The whole of this control action may be represented graphically by the curve *d* of Fig. 4 in which the abscissae represent the ratios of the interfering carrier field strength to the wanted carrier field strength such as they are present at the input of the receiver and the ordinates represent the same ratios across the rectifier SR which are thus proportional to the A. D. S. tensions.

It is supposed that the device is adjusted so that the desired ratio 1:320 (this ratio being in fact imaginary) across SR is realized exactly for an input ratio of 1:1; an ideally efficient action of the selectivity control device would be expressed by a horizontal line; the efficiency of the device is the more pronounced the more curve *d* is inclined towards the horizontal. The minimum or normal selectivity position of the receiver is represented by the straight line *d* min; that of the maximum selectivity by the line *d* max. These limits are usually attained because of the enormous range of variations at the input. The control action grows more pronounced if the amplification of the auxiliary control channel is increased and it depends closely on the characteristics of the fidelity regulation tubes or other regulation means, but with the proposed arrangement the steepness of the control curve *d* does never grow zero or negative. An advantage thereof is that no critical initial adjustments are required.

A better efficiency is often attained if the premature action of the rectifier for small interference levels is prevented, e. g. by biasing the rectifier SR negatively. The action of regulation would then and for a given degree of bias be represented by curve *d'*. The difference between the two curves resides, from a principal viewpoint, in the fact that the second arrangement has the tendency to keep the output ratios at a value corresponding to the delay tension of the rectifier SR, from a practical view-point the advantage consists in that a given absolute variation of the A. D. S. tension capable of producing a given effect corresponds to a much smaller percentual variation of the H. F. tensions applied to the rectifier.

A comparison of the two curves *d* and *d'* shows furthermore that curve *d'* has a higher average level corresponding thus to a smaller average selectivity; on the other hand an increase of the sensitivity of the device has the tendency to produce an opposite variation. This phenomena is without any importance, as it may easily be corrected in the receiver section which follows the branch-off point **20**. Means may also if desired be incorporated to allow a manual setting of the average selectivity degree, apart from the automatic control whose object is to maintain this setting constant under varying conditions; these means may modify the response curve of the second receiver section, or they may alternatively comprise a variable delay tension for the rectifier SR.

Some of the suppositions previously made are not always fulfilled exactly, or some small additional means are necessary to this end.

It was assumed that the efficiency of the gain control device operated by the wanted carrier was complete at the point **20**. With the devices usually used, it often occurs however that there remain appreciable differences, the high frequency tensions varying for instance in the ratio of 1:2 when tuning successively upon a weak, and upon a strong transmitter. With an efficient selectivity control action it might thus happen that the degree of selectivity is too large for strong "desired" transmitters, since the efficiency of the channel providing the A. D. S. tensions was not sufficiently reduced. This inconvenient may be eliminated in many different ways, and in the example represented by Fig. 1 the grid of the high frequency amplifier tube S2 in the selectivity control channel is also regulated by tensions varying inversely in dependence on the wanted carrier strength, by connecting it to the A. V. C. control line.

Also it might sometimes prove difficult for the A. V. C. channel to respond with sufficient sharpness upon the carrier which it is desired to tune in, particularly when the receiver was in a position of minimum selectivity and is rapidly tuned upon a weak transmitter. Additional selective circuits tuned upon the intermediate frequency and following the branch-off point **20** may to this end be included in this channel in addition to the circuit **29**, and these circuits may provide a rather flat-topped or any other response curve in the proximity of the nominal intermediate frequency whilst they help in providing a sharp cut off for the frequencies appreciably spaced therefrom.

It is possible for the same purpose to provide the receiver with an accessory device for placing it in a condition of predetermined e. g. average selectivity when the tuning cntrol is operated, as by placing the selectivity control device out of circuit, or by reducing its efficiency towards high fidelity degrees; such a device may comprise e. g. a tuning knob so disposed that its operation requires a small axial shift of 1–2 millimeters, a small axial spring restoring it to normal, and a switch being operated thereby; such devices have been proposed for other purposes and are sufficiently well known as to require no further description.

No detailed reference has 'till now been made to the fact that the fidelity degree of the receiver is also controlled after the branch off point **20**, in the example shown by connecting the line **2** A. D. S. to the control grid of the tube **24** and thus controlling the means associated with the anode circuit of this tube. It will be easily understood that since this control does not exerce any repercussion upon the tensions reaching the rectifier SR, any desired degree of fidelity may be easily adjusted by this means.

This regulation could theoretically operate with such a high efficiency as to render unnecessary a control of the circuits preceding the branch off point, these circuits being constantly adjusted to a high degree of selectivity so as to render unprobable the interference even by a relatively strong transmitter. There are however several reasons which render it disadvantageous of using this method alone.

One of these reasons is that the extremely wide range of the variations to which is submitted the ratio of the wanted to the interfering field strengths makes it very difficult if not impossible to design the amplifier, rectifier and selectivity regulating means of the selectivity control device so that they will properly handle tensions truly corresponding to these ratios. It is most desirable to provide means for compressing the said range, i. e. to let it be represented by tensions which vary between moderate limits only. The arrangement represented by Fig. 1 operating according to the so-called true control cycle principle is very efficient for this purpose, so that additional means for this purpose may be dispensed with, (these additional means being described with reference to other drawings and desirable in other instances).

With the arrangement of Fig. 1, as was already explained, the interfering carriers are efficiently transmitted by the common receiver section, when they are weak, that is, when an efficient amplification is most desirable; in this case the relative gain of the receiver corresponds to curve c_1 of Fig. 3*a* (this fig. having already been mentioned).

Strong interfering carriers on the other hand are not efficiently transmitted by the amplifier section common to the receiver proper and the selectivity control device. Under such conditions a sufficient amplification is very easy attained in the selectivity control channel, curve c'_2, Fig. 3*b* showing the frequency response in this channel under these conditions. It is thus seen that the proposed arrangement does not reduce the outmost degree of sensitivity of the selectivity control amplifier, and that the common amplifier section is efficiently used for the amplification of the selectivity control tensions.

It is not essential however that this section be utilized up to a point which closely precedes the demodulator-rectifier, and energy for the selectivity control channel might also be derived from some other point in the carrier frequency amplifier, this being more advantageous with those types of selective filters in the selectivity control channel which do not allow a suffiicently sharp removal of the carrier.

The types of filters represented by Fig. 1 and more particularly the quartz filter are not the sole ones allowing to attain the result in question. Apart from the similarly operating mechanical resonators such as tuning forks and magnetostrictive devices the properties of which are well known, it is possible to use, and a sufficient degree of carrier frequency attenuation is secured, by many other circuits known per se and operating e. g. on the bridge principle, some suitable examples being given with reference to other figures. It is also possible to include a frequency changer stage in the selectivity control channel, for changing the nominal intermediate frequency to a lower value, this facilitating the design of sufficiently selective circuits whilst at the same time a good deal of amplification is secured.

No DC amplification was used with the arrangement of Fig. 1 since the degree of high frequency amplification is so high that it is often possible with sensible regulation means to omit one of the stages shown; if required, the DC amplification could easily be designed by those skilled in the art; besides, some examples for so doing, and also for instoring upper and/or under limits of action of the control tensions and so avoiding overload of the regulating means associated thereby will be given with reference to other figures. Also there will be shown visual means for indicating the degree of fidelity, and some further fidelity control means.

No detailed reference was made so far to the type of noise caused by the so-called static. There are two kinds of such noises vz. those caused by lightnings, sparks of electrical machines or the like and occurring as irregular pulses of brief duration and large intensity and with appreciable intervals between; and furthermore those occuring as a rather regular and continuous background. This latter may be approximately assimilated to an interfering carrier station, whilst the former pulses may be integrated by a large time-constant, or have their intensity limited, or be suppressed, by blocking the amplifier channel, the means for so doing being sufficiently well known per se as to require no further description.

It is to be noted that the degree of interference, and the required degree of fidelity reduction, are not always the same with an interfering carrier wave and a static wave, for an equivalent tension set up across the fidelity control rectifier.

Whilst for small relative interference degrees the two kinds of interferences require about the

same degree of selectivity (or reduction of fidelity), for strong relative interference degrees their influence is distinctly different, up to such a point that an adjacent carrier of intensity equal to that of the wanted carrier requires an average selectivity degree whereas if the "static" causes an equivalent tension across the selectivity control rectifier the audition of the transmitter must be abandoned because even with the maximum selectivity degree the noise is exaggerated.

In Fig. 5 the ordinates represent the optimum selectivity degrees for different ratios of the wanted field-strength to the interfering field-strengths, these latter being indicated on the abscissae; the curve *ii* relates to an interference caused by an adjacent transmitter and the curve *bi* to an interference caused by the "static."

It is advantageous to use a single fidelity control device operated by that one of the two interference kinds which is the strongest, and this is easily possible by the device represented on Fig. 1.

It will be seen from Fig. 5 that the maximum selectivity degree could as well be required for an adjacent carrier about a hundred times stronger than the wanted one as by a background of static nearly equal in strength to the wanted transmitter; under these conditions the two interference kinds should give the same output across the rectifier SR. It will be seen that a curve similar to c'_2 is able of giving this result, the response for frequencies spaced by about ± 10 kc being but a small fraction of the response at the two peak frequencies, these responding to the background.

When a small selectivity degree is required, the two kinds of interferences on the other hand exert approximately the same influence since the peaks of maximum response are in this case situated near the frequencies ± 10 kc/s where the interfering carriers are likely to operate, this being shown by the curve c'_1 of Fig. 3*a*.

In Fig. 7 is shown another arrangement wherein the circuits responsive to the interferences are constantly tuned upon the frequencies where the interfering carriers are likely to operate, i. e. they present their outmost response for frequencies spaced from the intermediate one by some 10 kc/s, the response curve presenting two peaks, one on either side of the intermediate frequency, separated by a very marked depression; the resultant resonance curve is that of Fig. 6 where the frequencies are indicated horizontally, the wanted one being taken as a point of reference and marked zero, whilst the relative gain of the amplifier up to the selectivity control rectifier is indicated vertically.

As shown, the receiver system includes a first section which is common to the receiver proper and to the selectivity control channel, and has been generally represented as the "pre-amplifier" PRE; it embodies preferably a frequency changer device of any well known kind, and also if desired a radio frequency amplifier tuned upon the frequency of the wanted signals. This first amplifier section does not embody means for controlling the degree of selectivity, in the example shown. The output at intermediate frequency which appears in the circuit **47** tuned upon the nominal intermediate frequency, is transferred as by mutual inductance, to the tuned circuit **48** connected across the input terminals of the first intermediate frequency amplifier valve I**1** of the receiver; in cascade with this is another receiver valve I**2** for amplifying the intermediate frequency, these two valves being coupled by a band pass filter comprising the two tuned sections **49** and **50**, both tuned upon the nominal intermediate frequency and preferably individually screened, as by screening cans; they are coupled by means of a small condenser comprising a fixed plate **67** connected to the top of the circuit **49**, and a movable vane **68** connected to the top of the circuit **50** and fixed upon a shaft **66** which may be easily rotated; this shaft is grounded, the plate **68** being isolated by means of the part **69**. The two circuits **49** and **50** are weakly coupled if the condenser **67—68** is small and the resultant resonance curve presents in this case a sharp peak upon the nominal intermediate frequency, this position being suitable when a high selectivity degree is required. When the condenser **67—68** increases its value the band-pass width is expanded, especially towards frequencies lower than the nominal intermediate frequency. The anode circuit of the amplifier valve I**2** includes a tuned circuit **51**, this circuit resonating exactly upon the intermediate frequency when a high degree of selectivity is required. When an increased fidelity degree is required, this circuit may be slightly detuned towards higher frequencies; this is rendered possible by connecting one plate **70** of a small condenser to the top of this circuit **51**, the other plate of the condenser **71** being connected to ground and thus effectively in shunt with the tuned circuit, and being fixed upon the grounded shaft **66**; this detuning gives in conjunction with the asymmetrical expanse of the filter **49—50** a resultant response which is symetrical with respect to the nominal intermediate frequency, the condenser **67—68** may be replaced by a differential condenser arrangement having two small fixed plates connected to the tops of the circuits **49**, **50** respectively between which is movably arranged and fixed to the shaft **66** a small grounded screening plate. The circuit **51** transfers by mutual inductance the main of its energy to the tuned circuit **52** which is included in the branch of the receiver LF which includes a demodulator, an audio frequency amplifier and a reproducer. Part of the energy of the circuit **51** is also fed through the condenser **53** to the automatic gain control device A. V. C. which is of a well known kind and exercises its action upon the "preamplifier," upon the intermediate frequency amplifier of the receiver, and also upon a further valve S**1**. This valve is the first high frequency amplifier valve of the selectivity control channel and is fed by the circuit **47** through the condenser **54**. It is of the hexode type and comprises in addition to the main control grid a so-called gain control grid which is also controlled by the A. V. C. line. The anode of the tube S**1** is coupled to the second high frequency amplifier tube S**2** of the selectivity regulating channel by the intermediate of a network comprising an anode coil **55** coupled to a so-called Campbell sifter **56** this latter including the tuned circuit **57** and the two coupled coils **58**, **59** with the condenser **60** of such value as to tune the circuit upon the intermediate frequency. This sifter circuit attenuates therefor considerably the wanted carrier frequency whilst it gives a good energy transfer at frequencies distant by several kilocycles from the intermediate frequency.

The tube S**2** feeds the selectivity control rectifier S**1**R through a band pass filter indicated generally by the reference **61** and comprising an anode circuit tuned upon the nominal intermedi-

ate frequency and coupled by means of the series resonant circuit 64 comprising an inductance and a condenser also tuned upon the nominal intermediate frequency, to the second parallel resonant circuit 63, the values being so chosen as to give a good energy transfer at the frequencies of the interfering carriers whilst a small amount of wanted carrier frequency energy is only transmitted, the effect of the circuits 56 and 61 being therefor cumulative. The rectifier S1R is of the diode type and biased negatively so as to prevent rectification to take place below a predeterminated value, (this presenting not however in the present case quite the same interest as with the arrangement of Fig. 1). The rectified output after having been filtered, may be directly used to actuate part of the fidelity control means through the line A. D. S., these means having not however been represented, and it is also applied to the grid of the valve S2. This connection fulfills a triple purpose.

Firstly this valve serves as a DC amplifier for the A. D. S. tensions such as rectified by the diode S1R, the DC tensions which are applied thereto modifying its anode current, whilst the tube continues to operate at the same time as a high frequency amplifier. This current traverses a small motor M of the galvanometer type, of a well known kind, for instance of the moving coil type, and causes rotation of the shaft 66 against spring action and hence adjustment of the condensers 67—68 and 70—71 in dependence on the current variations of the tube and thus on the applied A. D. S. tensions. To avoid undesired interactions, one side of the motor is connected to the high tension supply, and the other side to the "cold" terminal of the tuned circuit 62, through the line 2 A. D. S., this terminal being also grounded for the high frequency energy through a by-pass condenser. Obviously any suitable regulation curve may be obtained by suitably shaping the plates of the variable condensers 67—68 and 70—71, since there is no repercussion of the fidelity control upon the control channel.

The valve S12 has a variable mutual conductance and acts also very efficiently to compress the range of variations of the interfering high frequency tensions reaching the rectifier S1R since an increase in the strength of the interfering carriers causes an increased negative A. D. S. tension which decreases the transmission efficiency of the control channel. The output of the rectifier does not therefor reach such high values under strongly interfered conditions, whilst under weakly interfered conditions the transmission efficiency is optimum, since the biased rectifier does not respond to such small carriers. The considerable practical importance of some such compression was already shown, and is the more valuable as there are no controlled fidelity means in the "preamplifier" which would give the same effect.

This compression takes furthermore place for the DC tensions rectified by S1R, since for large DC tensions as applied to the tube S12 the current variations in the galvanometer motor are small, whilst they are comparatively large for small DC tensions applied to the tube which has then a large mutual conductance.

The current variations of the tube S12 might as well be used to give other fidelity control effects such as varying the inductance of tuned circuits in the carrier amplifier channel, as by causing them to flow through an auxiliary winding associated with an iron core in the field of which is a small winding upon an iron dust core and which forms the inductance of such a tuned circuit. Other selectivity control means will not be further enumerated since they are sufficiently well known per se.

Upon the shaft 66 is also fixed a pointer 72 moving before a graduated scale or intercepting a beam of light to a variable extent and giving therefor indications on the degree of fidelity with which the station may be received. This or some similar device is very suitable for rapidly determinating whether a station is worth while listening, when the tuning control is operated and no program is radiated in the particular moment by the carrier, or when the manual volume control knob is turned towards zero or when the operator has not a sufficiently skilled musical ear.

Other forms of indicators known per se may be used as well and may be operated by tensions derived from the A. D. S. channel.

It will be seen that with the arrangement of Fig. 7 the transmission efficiency of the selectivity control channel up to the rectifier S1R (including the "preamplifier") was varied inversely in accordance with the field strength of the desired station so that the initial range of the variations of the field strength of the interfering carrier was considerably expanded and in fact doubled (when the level variations are expressed in decibels). The action of the compression device (provided it was efficient) consisted therefor necessarily in the re-compensation of an essential part of the transmission efficiency variations according to the wanted carrier strength which were introduced by the A. V. C. device.

Fig. 8 shows a modified arrangement wherein the said variations are introduced mainly at a point in the auxiliary channel which follows the "compressing" rectifier, and it also serves to illustrate a means whereby a suitable frequency response of the fidelity control channel with an efficient attenuation of the "wanted" carrier has been attained through the cooperation of selective circuits in the "receiver" channel and in the auxiliary control channel.

This arrangement comprises a "preamplifier" including a frequency changer device with the intermediate frequency energy appearing across the tuned circuit 73, from where the "receiver" channel is fed through the condenser 74, this channel comprising an input band pass filter 75, a first intermediate frequency amplifier tube I21, coupled through the circuit 76 which is sharply tuned upon the intermediate frequency, to the second amplifier valve I22. In cascade therewith is a further amplifier section tuned upon the carrier frequency and generally represented by the reference IF. This preferably includes means for varying its degree of selectivity and is followed by a demodulator and audio frequency amplifier means. The selectivity control channel is fed from the "preamplifier" through the condenser 78 of low value and comprises an input band pass filter 79, a first high frequency amplifier valve S21, in the anode circuit of which there is a resonant circuit 80 tuned upon the nominal intermediate frequency and which preferably is rather damped. The coupling of the two circuits of the band pass filter 79 is rather tight so as to give a broad resultant resonance curve, whilst that of the similar band pass filter 75 in the "receiver" channel is rather loose so as to give a sharply peaked resonance curve. It is seen that

the constitution of the first sections of the "receiver" amplifier and of the selectivity control amplifier, up to the tuned circuits 76 and 80 is quite similar, apart from the differences of their band pass width. The second selectivity control amplifier valve S22 is coupled to both these channels by means of the two coils 81 and 82 coupled to the circuits 80 and 76 respectively, these coils being connected in series, and connected in shunt across the input electrodes of the tube S22; these coils pick up equal amounts of energy at nominal intermediate frequency, but of opposite phase relationship, so that the desired carrier is substantially cancelled out whilst frequencies removed from the nominal intermediate frequency, and more particularly the frequencies of the interfering carriers, are not too much attenuated.

It is necessary in order that the balance of this circuit shall not be offset to exerce no gain control action upon the tubes S21 and I21, or to exerce such an action in equal proportions upon the two tubes. The anode of the tube S22 is coupled to the rectifier *i*R through a network presenting a marked double humped response ensuring a good transmission efficiency to the interfering carriers and a less good transmission to the wanted carrier, this network comprising connected between the anode of the tube and between the high tension supply a rather flatly tuned circuit 83 to which is coupled an absorption circuit 84. The rectifier *iR* is of the diode type and has its cathode connected to the cathode of the tube S22, and also to the cathode of a further amplifier tube S23 in the selectivity control channel. The control grid of the tube S22 and the gain control grid of the tube S23, which tube is of the hexode or like type, are controlled by the negative DC tensions set up across the load resistance 85 of the rectifier IR by the interfering signals.

These tensions represent on a compressed scale the variations of the input strengths of the interfering carriers and also up to some extent the variations of the wanted carrier since in the arrangement shown the common preamplifier was subject to gain control derived through the line A. V. C. In order that these latter variations shall be of sufficient amplitude relative to the variations of the interfering carrier values it is necessary to exerce thereupon some supplementary action inversely in dependence on the wanted field value. The degree of this supplementary action depends on the degree of compression to which were subject the high frequency tensions reaching the rectifier *i*R and this action is carried out in the DC amplifier tube S23, which comprises two control grids giving a multiplicative effect. Since the tensions derived from the rectifier *i*R are of "normal" phase, that is, the control line growing more negative for increasing values of the interfering carriers, it is necessary that the tensions dependent on the strength of the wanted carrier and which are applied to the main control grid, of this tube, shall be of reversed phase. They are derived from the anode circuit of a tube controlled by the normal gain control tensions, in the example shown of the tube I22 which tube includes a resistance connected between the source of high tension supply and the bottom of the tuned anode circuit 77, part of the DC current variations set up there across being lead of through the line Reverse A. V. C. by means of a potentiometer connected between the resistance and ground; the cathode of the tube S23 and also the cathodes of the associated tubes are at such a potential relative to ground that for maximum gain control tensions the negative bias of the tube S23 is slightly negative. In the anode circuit of this tube is included a resistance 86 across which are therefor set up DC tensions which depend directly on the strength of the interfering carriers and inversely on the strength of the wanted carrier, and it is easy to find out the degree of reverse A. V. C. action for which these tensions are truly representative for the ratios of the interfering field strength to the wanted field strength at the input of the receiver.

They may be used directly for actuating the fidelity regulation means in the intermediate frequency and/or audio frequency sections of the receiver. On Fig. 8 has also been shown by way of example one manner for reducing the range of the transmitted audio frequencies towards the treble by means of a low pass filter connected between a first section of the audio frequency amplifier LF1 and between a further amplifier tube 96 to which is coupled the final low frequency amplifier. This low pass filter comprises a variable condenser connected between the input terminals of the amplifier tube 96 and associated with the fixed inductance 93, the variable condenser being constituted by the apparent input impedance of an auxiliary thermionic tube A2 of the triode type the grid of which is connected to the grid of the tube 96 through the condenser 95, and which exhibits the so-called "Miller effect" that is, the apparent variation of its capacitative impedance when its amplification is varied, due to a variation of its negative grid bias; for this purpose the tube A2 comprises a resistance 94 in its anode circuit and has its grid to anode internal capacity increased by means of a small external condenser. Its grid bias is controlled by part of the fidelity control tensions derived from the anode circuit of the tube S23 through a potentiometer 87—88 connected between ground and anode in a manner which will be detailed hereinafter.

There is also connected between ground and high tension supply a potentiometer comprising the two resistances 91 and 92; which are of such value that the point of intermediate potential so determined is at a fairly large negative potential with respect to the cathode of the tube A2. Connected to the point of variable potential on the potentiometer 87—88 is the anode of a diode, the cathode of which is indirectly heated (this being not represented) and connected through the resistance 90 of high value to the point of fixed potential on the potentiometer 91—92.

Under strongly interfered conditions the junction point of the resistances 87—88 assumes a potential which is but little negative with respect to the cathode of the tube A2 and at an appreciable position with respect to the junction point of the resistances 91—92; the diode is therefore conducting and has a small internal resistance, so that the grid of the tube A2 may be practically considered as being at the potential of the junction point 87—88. Therefor this tube secured a high amplification and simulates a large condenser, so that the cut off frequency of the associated filter is low. For weak interferences or a strong desired carrier, the opposite condition takes place up to a point of high cutoff frequency when the diode 89 ceases to conduct.

The potential difference between the anode of the tube A2 and ground, which varies inversely to that of the anode of the tube S23 with respect to

the ground, has also been used for operating a visual indicator N of the neon type the cathode of which is connected to ground through the resistance 97, the purpose of which is to limit the flow of current, its anode being connected to the anode of the tube A2, or to some suitably chosen point on its anode resistance 94, so that the tube illuminates either constantly or for degrees of fidelity over a predetermined valve only, the degree of illumination increasing with an increase of fidelity, i. e. under less interfered receiving conditions.

In Fig. 9 there is shown a further arrangement which serves inter alia to illustrate another way for compressing the range of variations of the interfering carriers. The "preamplifier" comprises a radio frequency amplifier valve 98 associated with tunable circuits and a frequency changer device referred to as OM, this latter including in the anode circuit of the first detector a network 99 comprising a circuit 101 tuned upon the nominal intermediate frequency and in series therewith one half of the small coupling coil 103, and in shunt therewith a resistance 100 in series with the other half of the coupling coil 103, the common intermediate point on the coil 102 being connected to the high tension supply.

The damping of the tuned circuit 101 is small, and the value of the resistance is equal to the impedance which the tuned circuit offers to the nominal intermediate frequency. The "receiver" amplifier is coupled to the circuit 101 by mutual inductance between this circuit and the tuned input circuit 102 of the first intermediate frequency valve 131. The A. V. C. device is also fed from some point of the intermediate frequency section of the receiver amplifier REC, the action of the automatic gain control device being conventional and exercising inter alia upon the tubes 131 and 98, this latter control also modifying the energy transferred to the selectivity control channel. This channel being fed by virtue of the mutual inductance between the coupling coil 103 and a circuit 104 tuned rather broadly upon the nominal intermediate frequency so as to offer a substantial impedance to the interfering carrier. It will be seen that, as the two halves of the coupling coil 103 induce equal voltages at nominal intermediate frequency and of opposite phase, this nominal frequency is substantially cancelled out, whilst for the interfering carriers the amount of voltages induced is substantially different so that a considerable amount of these frequencies is transmitted.

Connected to the anode of the high frequency amplifier tube S31 there is a tuned circuit 105 the other terminal of which is grounded for the high frequency energy through a large by-pass condenser and connected to the high tension supply through a resistance 111. The circuit 105 is coupled to the tuned circuit 106, as by mutual inductance, so tightly that the resultant band pass filter presents a marked double humped characteristic ensuring an efficient transmission to the energy of the interfering carriers. This energy is applied to a dry rectifier S3R e. g. of the well known copper oxide type, the negative tensions set up across the rectifier resistance being applied through the line *i* to the main control grid of the tube S31, and also to the gain control grid of the radio frequency amplifier valve 98 of the common "preamplifier" channel for a purpose which will be described hereinafter. Since both these valves are in the selectivity control channel, one first effect of this control is that the high frequency variations reaching the rectifier S3R are efficiently compressed, this result being very desirable as has been shown. The tube S31 is of the hexode or a like type and comprises also a "gain control" grid to which are applied reverse A. V. C. tensions derived from the anode circuit of a tube which is controlled by the normal gain control device, in the instance shown the intermediate frequency amplifier tube I31; the anode circuit of this tube comprises for this purpose a resistance 109 part of the potential variations set up across this resistance being taken off by means of the potentiometer 110 connected between the top of the resistance and a source of negative potential with respect to ground. The potentials are so chosen that for full A. V. C. voltage applied to the tube L31 the gain control grid of the tube S31 assumes approximately ground potential, whilst for smaller A. V. C. voltages it grows increasingly negative with respect to ground. This reverse A. V. C. action counteracts to some extend the action of the gain control device as has been exercised upon the selectivity control channel prior to the rectifier SR3, (this action having been exercised in the instance shown upon the common preamplifier tube 98); for this reason the potential variations led off at the rectifier S3R represent approximately the variations of the field strength of the interfering carriers (as distinct from the relative strength of these carriers), on a considerably compressed scale. A small degree of control action in dependence on the strength of the wanted carrier at some point following the rectifier S3R, will therefore be sufficient for providing correct A. D. S. tensions, and this action is efficiently carried out in tube S31 in a fashion similar to that which was described with reference to fig. 8, vz. by the simultaneous application in respectively opposite phases of DC tensions derived from the amplifiers for the wanted and for the interfering carriers respectively. The A. D. S. output appears in the anode resistance 111 of the tube S31 which thus serves at the same time as a DC and as a high frequency amplifier for the selectivity control tensions. It is easy to find the correct degree of reverse A. V. C. control, since the effect of the "counter action" of this control upon the high frequency amplification of the tube (which counter action is only apparent as was shown) is seriously smaller than its effect action upon the DC amplification.

The gain control along line *i* of the radio frequency valve also fulfils the purpose of minimising the so-called crosstalk which frequently occurs with radio receivers having an efficient signal collecting means, and/or an appreciable radio frequency amplification preceding the frequency changer stage. This risk of crosstalk with its well known disadvantages such as apparent selectivity decrease and distorsion is most likely to occur in the radio frequency, and frequency changing stages. It exists especially if the wanted transmitter is neighboured by a strong adjacent transmitter, and since in such cases considerable tensions are set up across the rectifier S3R which responds to such a transmitter, these tensions may be used to avoid the said risk. In the example shown, this result has been attained in as far as the radio frequency amplifier tube is concerned by reason of the increased "admission" of the control grid due to the increased negative bias of the gain "control grid" which flattens the characteristic of the tube as is well known, and

inasmuch as the frequency changer stage is concerned by reason of the decreased gain due to the same control. The output of the receiver on the other hand is practically not concerned thereby as there is sufficient gain control through the A. V. C. line upon the various tubes to make good for this voluntary reduction of sensitivity.

The result just mentioned could be obtained by many different ways, e. g. by decreasing the input voltage of the radio frequency tube by means of an auxiliary tube placed in shunt across the tuned input circuit so as to lower its impedance, and the arrangement may again be such that a decrease of the voltage applied to the input of a radio frequency, or the frequency changer stage, is accompanied by an increase in selectivity, or by using in at least one of the intervalve couplings in the early amplifier stages a band pass filter with sharply resonant primary the secondary of which is shunted by an auxiliary tube serving as a variable resistance, this giving at the same time a decrease of sensitivity and an increase in selectivity. Other circuits known per se may also be used for the present purpose. Modifications of the proposed arrangement such as the use of a second rectifier fed in parallel with S3R and responding to tensions above a given value only, as by biasing it negatively, with the purpose of causing the control to operate only for strong interfering transmitters and using the optimum sensitivity for weak transmitters which are not subject to the risk of crosstalk, and also reducing the background noise due to valve hiss and the like, will be obvious to those skilled in the art.

The tensions across the resistance 111 may also actuate a visual indicator of quality through the line Vis. which may e. g. be of the cathode-ray oscillograph type.

Fig. 10 shows a modification of the arrangement just described wherein the correct efficiency of the tensions rectified in the rectifier S3R is attained by means of a motor galvanometer 112—113 for operating the selectivity regulating means, this galvanometer comprising two differentially connected windings, of which the one, viz. 112 is traversed by a current depending on the output of the rectifier S3R by including it in the anode circuit of the tube S31, which is controlled by this rectifier whilst the other winding 113 is traversed by a current dependant on the strength of the wanted carrier, by including it in the anode circuit of the tube 131.

This differential action is only strictly correct for a suitable (logarithmic) compression law of the channels producing the tensions dependent on the wanted and on the interfering carriers respectively.

In actual practice the requirements are however less critical and may be sufficiently well performed by choosing for S31 and I31 tubes of the variable mu kind having approximately the required characteristic: the requirements are still further lowered when a certain amount of control action by the wanted carrier was effectuated prior to the rectifier S3R; this may easily be the case by reason of the usual gain control of the "preamplifier," this action being in the present case not offset or lowered since the tube S31 need only have one control grid and need not be controlled by reverse A. V. C. tensions.

A like differential effect could also be attained by leading off the selectivity control tensions from a resistance traversed simultaneously by the anode current of a first valve controlled by the rectifier of the channel tuned upon the signals and by another valve controlled by reverse A. V. C. tensions. It may sometimes be preferable to use, instead of a galvanometer with two differentially connected windings, a galvanometer of the wattmeter kind comprising a moving coil traversed by the current of one of the valves, and a further fixed winding for modifying the magnetic field in which operates the first winding.

Fig. 11 serves inter alia to illustrate the way in which part of the fidelity control means may be directly controlled by tensions depending chiefly on the strength of the interfering carriers, and to a smaller extent on the strength of the "wanted" carrier, and also a way of giving selectivity control tensions of reversed phase.

As shown the receiver is of conventional type and comprises a radio frequency amplifier RF, a frequency changer device OM, these two also in the path of the selectivity control channel, and comprising no selectivity control means in the arrangement shown; coupled thereto by mutual inductance between the tuned circuits 114, 115 tuned upon the intermediate frequency, is an intermediate frequency amplifier IF feeding the demodulator and low frequency amplifier DL and a gain control device A. V. C. which operates through the line A. V. C. and modifies inter alia to a certain extent the transmission efficiency of the comon "preamplifier." Both the two receiver sections IF and DL may include means for controlling the fidelity and operated in accordance with my invention.

The selectivity control channel comprises an input circuit 116 coupled by mutual inductance to the circuit 115 and connected across the input terminals of the first high frequency amplifier tube S41, and is also in the anode circuit of an auxiliary triode tube A41 which functions as a variable resistance to vary the decrement of the tuned circuit, for the purpose and in a manner described hereinafter. The anode circuit of the tube S41 is coupled to the rectifier R*i* through a network 117 comprising a resistance and a tuned circuit sharply tuned upon the nominal intermediate frequency and differentially connected to the rather damped tuned circuit 118 tuned upon the intermediate frequency (a similar filter having already been described previously) this diode-rectifier producing in accordance with the strength of the interfering carriers potential variations negative with respect to ground in a resistance 119 and positive with respect to ground in the rectifier resistance 120; these latter tensions being inter alia applied through the line *i* to the grid of the tube S41 so as to compress the range of the variations of the tensions which are applied to the rectifier R*i*. The tensions applied thereto depend mainly on the strength of the interfering carriers, and to a smaller extent on the strength of the wanted carrier. The DC tensions apeparing across the resistance 120 are filtered and applied through the line *is* to the grid of the auxiliary tube A41, the cathode of this tube being at a high potential with respect to ground corresponding to its cut off bias, so that in the absence of interfering carriers as applied to the rectifier R*i* the internal resistance of the tube is extremely high and does not cause an appreciable damping of the associated circuit 116: under these conditions the coupling of this circuit with the transformer 114, 115, is rather tight and causes a marked absorption of energy at intermediate frequency, this resulting in a broadening of the resonance curve thereof and in a

better degree of fidelity, the loss of sensitivity needing not be considered inasmuch as the receiver channel is concerned. Under the same conditions the response curve effective across the tube S41 is also broadened due to the interaction between the circuit 116, and the band pass filter circuits 114, 115, and the transfer of energy of the interfering carriers is therefore good.

If however due to a strong interfering transmitter the negative bias of the tube A41 is decreased, its internal resistance is lowered up to small values, causing considerable damping of the associated circuit 116, this on the one hand reducing the amount of energy transmitted to the tube S41 and so efficiently contributing to the compression of the variations of tensions applied to the R*i*, and on the other hand effectively decoupling this circuit 116 with the associated transformer, so that the response curve of this latter grows more sharply peaked with a concomitantly increasing degree of selectivity in the receiver and also in the selectivity control channel, this latter effect in turn causing a further decreased response of this channel to the interfering carriers and thus a further improved compression. It is to be noted that the loss of sensitivity for this channel is not compensated by the A. V. C. device. A further amplifier section of the selectivity control channel includes a high frequency amplifier tube S42 fed from the intermediate frequency channel of the receiver preferably from a point close to the demodulator through a small condenser 124 and a loosely coupled sharply resonant band pass filter 121; these tensions mainly of nominal intermediate frequency are amplified by the tube S42 to a variable extent in dependance on the strength of the interfering carriers, by connecting the grid of this tube to the rectifier R*i* through the tuned grid circuit. Energy at carrier frequency is transferred from the anode of the tube S42 through the sharply resonant band pass filter 122 to the rectifier S4R, of the diode type. The output tensions appearing in the load resistance are negative with respect to ground and their phase is such that a relative increase in strength of the interferences caused a smaller negative tension, since less energy of intermediate frequency is thereby transmitted. These tensions serve to actuate the fidelity control means, through the lines A. D. S., and they depend both on the strength of the interfering carriers, and of the wanted carrier, the tube S42 being preferably controlled to such an extent that with the fidelity control through the lines A. D. S. the action of this latter carrier predominates since with the selectivity control exercised upon the selectivity regulating means 115—116 the action of the interfering carried predominated, so that finally both exercise a correct action.

It is furthermore seen that the A.D.S tensions appearing across the load resistance of the rectifier S4R depend strongly on the degree with which the receiver is in tune with the wanted carrier, a small amount of detuning having the same effect as a considerable decrease in the strength of the carrier and corresponding thus apparently to a degree of small fidelity and of strong interferences. If these tensions are therefore applied to a visual indicator of any suitable type known per se which may be for instance of the oscillograph type, through the line A.D.S/VIS this indicator will exactly indicate the degree of fidelity when the receiver is exactly tuned; and it will at the same time allow the operator to exactly tune in this point which is characterized by the maximum deflection, or the maximum degree of illumination or like indication according to the type of the indicator. Fig. 12 serves to illustrate this operation, the frequencies being indicated horizontally, the wanted one being taken as a point of reference and marked zero and the degrees of illumination or like indications being indicated vertically, the curves *q*1 *q*2 *q*3 relating to stations which may be received under conditions of increasing fidelity. It is seen that no appreciable indication is given for amounts of detuning larger than some 3 kc. The device is particularly suitable in the receivers where the tuning is effectuated partially according to the indications of the ear of the operator, by known arrangements called e. g. aural tuning, such devices being inoperative in the momentary absence of a program and leading to difficulties in the cases where the receiver is audible only in close proximity of the exact tuning position. A visual indicator of tuning only, on the other hand, has not many applications in a receiver of the type mentioned and does not give useful indications on the "quality" of the station.

The arrangement shown by Fig. 13 serves to illustrate the way in which the high frequency tensions reaching the selectivity control rectifier, are caused to represent the variations of the ratio: interfering to wanted field strengths by the simultaneous action of a so-called true control cycle and by a variation of the transmission gain efficiency of the amplifier channel, feeding the said rectifier, the same arrangement also giving some further advantages of the so-called true control cycle which were detailed in connection with Fig. 1.

The receiver comprises a common "preamplifier" with frequency changer means, with intermediate frequency, demodulator and audio frequency sections and a gain control section, all of these similar to those of the arrangement which was just described. The selectivity control channel is fed in a like manner through the controlled tuned circuit 116 and the first high frequency amplifier tube of this channel which is of the hexode type, has both its main control and its "gain control" grids controlled by the A.V.C line to such an extent that the high frequency tensions reaching the selectivity control rectifier S5R have been subject to a "complete" action of the wanted carrier strength i. e. this action varying exactly inversely in proportion to the said field strength. The rectifier S5R which is coupled to the second high frequency valve S52 of this channel through the tightly coupled band pass filter 125 exercises a compression action upon this channel by connecting the control grid of the tube S52 to the line A.D.S; which is at a variable negative potential due to the DC tensions set up by the interfering carriers in the diode load resistance 126 connected between ground and diode anode. The tube A51 is controlled through the line 2 A.D.S in which are set up variable positive potentials derived from the diode load resistance 127, this control exercising a correct influence upon the degree of fidelity of the band pass filter 114–115 which further reduces the range of variations of the tensions as would otherwise be applied to the rectifier S5R and at the same time varies the amount of interfering energy derived through the circuit 116, this giving a cumulative effect like in the preceding arrangement. It is to be understood that with my invention the use of separate fidelity

regulation means actuated by tensions dependent on the strength of the wanted carrier is not precluded, these means if used, exercising preferably a small action on the overall fidelity degree only, so as to remediate, to an otherwise unsufficient such control.

Although I have described my invention as embodied in several concrete forms, it should be understood that the various means represented may be modified in many different ways. The rectifying means might for instance be of the push-pull-type, or of the 3 electrode type; in fact, any other means suitable for the purpose and known per se might be used. Also it should be understood that I do not limit my invention to the particular arrangements which were described since various modifications thereof will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

EGON NICOLAS MULLER.

PUBLISHED

MAY 25, 1943.

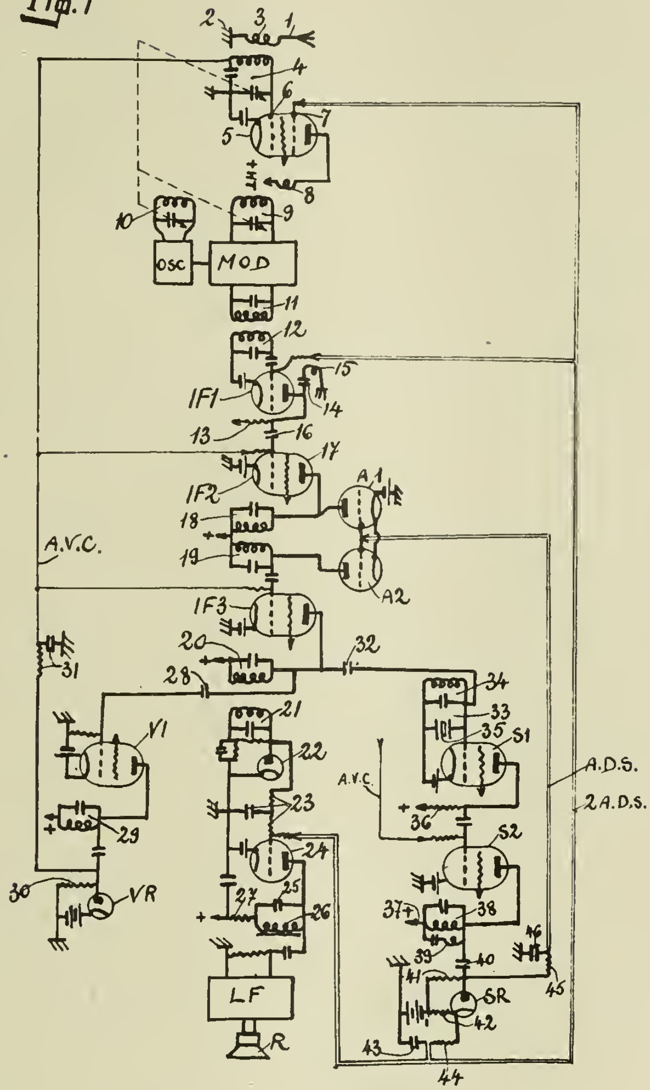
BY A. P. C.

E. N. MULLER
AUTOMATIC SELECTIVITY CONTROL
FOR RADIO RECEIVERS
Filed June 13, 1936

Serial No.
85,166

4 Sheets-Sheet 1

Fig. 1



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4 Sheets-Sheet 2

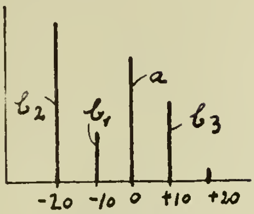


Fig. 2a

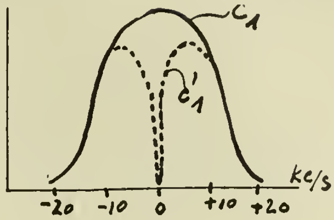


Fig. 3a

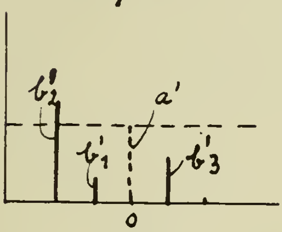


Fig. 2b

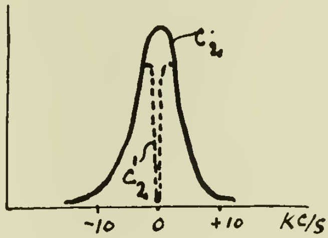


Fig. 3b

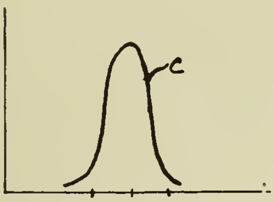


Fig. 2c

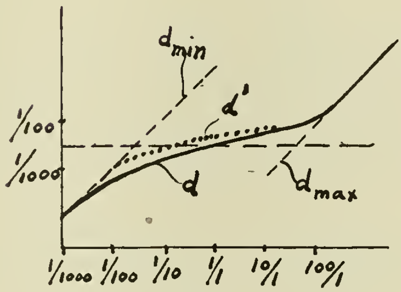


Fig. 4

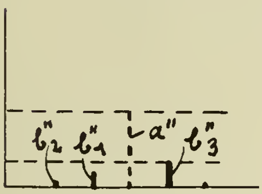
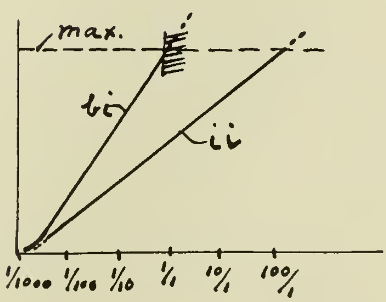


Fig. 2d



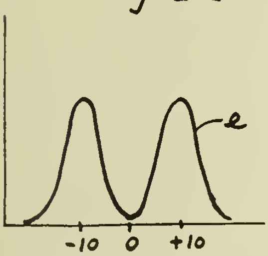


Fig. 6

Fig. 5

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Fig. 7

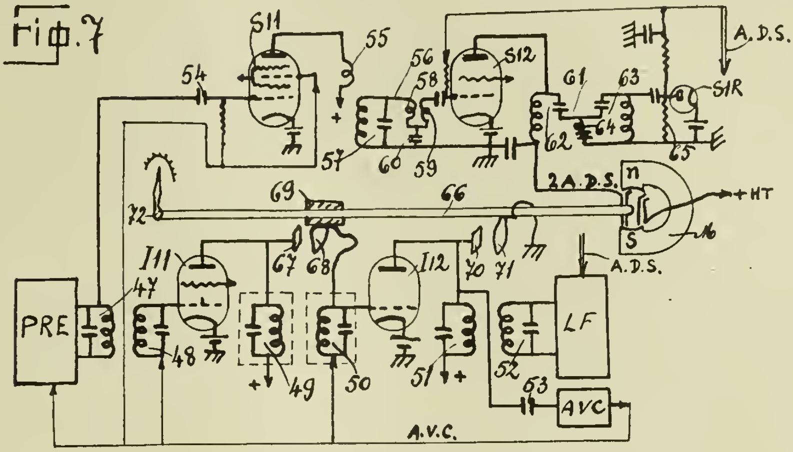


Fig. 8

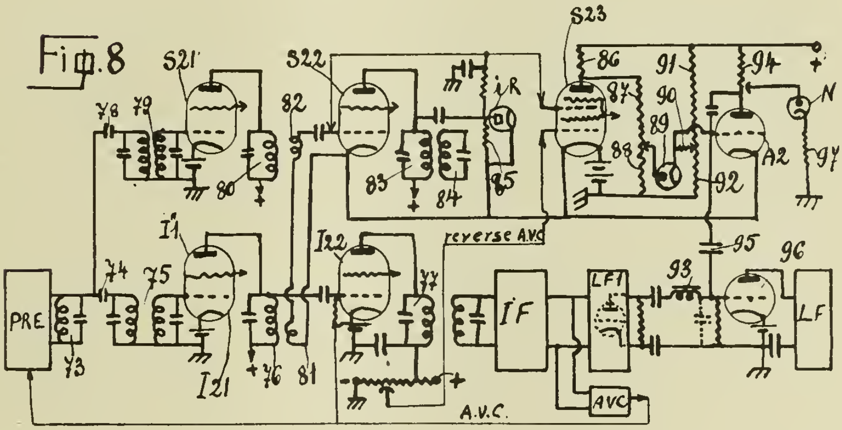
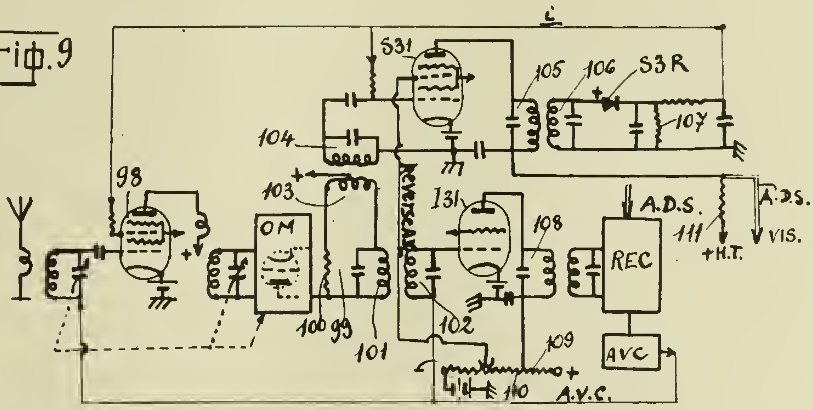


Fig. 9



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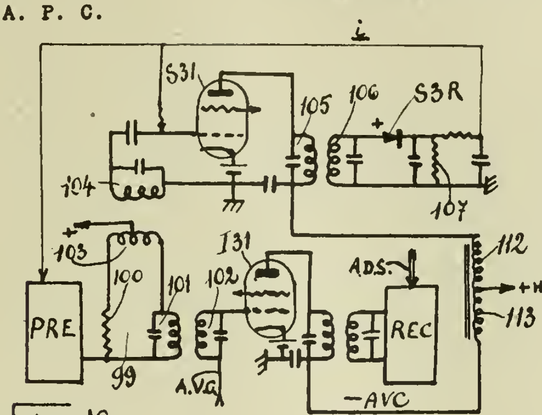

Fig.10

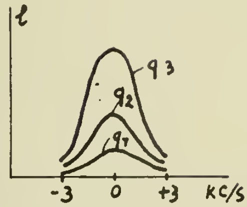

Fig.12

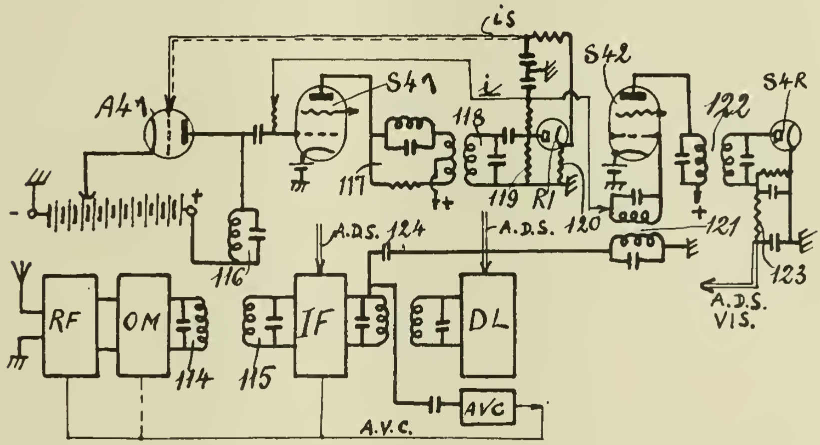

Fig.11

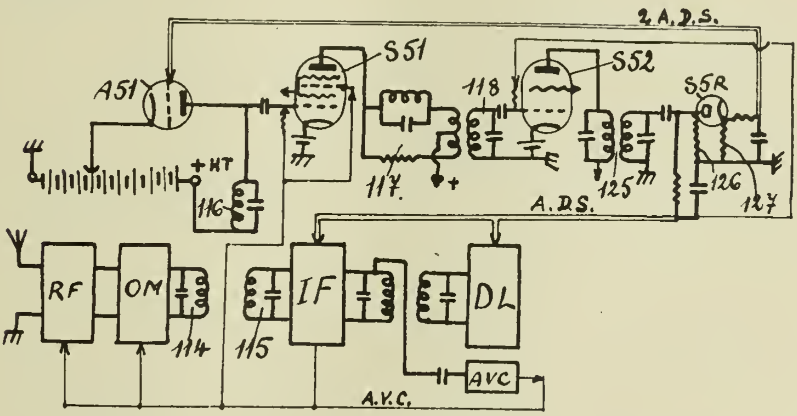

Fig.13

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ALIEN PROPERTY CUSTODIAN

PROCESS FOR THE REGISTRATION OF BUSINESS TRANSACTIONS

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The invention relates to a process for the registration of business transactions, e. g., the ascertaining of balances and the carrying forward of balances.

Up to the present the newly ascertained balance was printed numerically and on being carried forward as an old balance this numerically represented amount was read off and by striking of the corresponding figure keys was introduced into the machine. In these operations errors in reading off of the amount of typing errors could easily occur and sometimes remained undiscovered for a long time and thus necessitated a troublesome investigation and thereby a great loss of time.

According to the invention this disadvantage is now overcome, in that the newly ascertained balance in writing out e. g. in total-taking, is represented by symbols serving for the performance of the control operations, whereby these symbols on the next bookkeeping operation for the purpose of carrying forward this value as an old balance, automatically control the registration and printing mechanisms. An automatic writing-out of the new balance and an automatic bringing-in of the same as an old balance is thus rendered possible, so that typing errors are completely excluded.

In the drawings one form of construction of the subject of the invention is illustrated by way of example.

Figures 1 to 15 illustrate well-known mechanisms and are merely included in this specification for a better understanding of the invention proper.

Fig. 1 shows a side elevation of a typewriter calculating machine.

Fig. 2 shows on an enlarged scale a section to the line 2—2 of Figure 16 viewed from the left-hand side of the figure.

Fig. 3 shows a perspective illustration viewed from the front left hand side of the machine, of the drive coupling with the setting member, common to all the calculating keys, for the coupling, in which view the individual parts for the sake of better insight are represented drawn out from one another.

Figure 4 shows in perspective, details of the setting member, the parts of which are likewise drawn out from one another.

Figure 5 shows a perspective illustration of the transmission and control mechanisms arranged between the typing and calculating keys, viewed from the front left-hand side of the machine, together with the change over gear for the column totalizers and a part of the change over gear for the cross footer, in which view the individual parts are illustrated drawn out from one another.

Fig. 6 shows a perspective illustration of a locking mechanism controlled by the column totalizer.

Fig. 7 shows a perspective illustration of the total taking mechanism for the cross footer, with the printing mechanism for the sign in addition thereto and a part of the change over gear including both the driving wheels for the cross footer, the view being taken from the front left-hand side of the machine and various parts being illustrated drawn out from one another.

Fig. 8 shows in perspective the change over gear for the cross footer viewed from the front left-hand side of the machine.

Fig. 9 shows in perspective the unlocking mechanisms for the column totalizer and the cross footer, viewed from the front left-hand side of the machine.

Fig. 10 shows a side elevation of a typewriter calculating machine in which the tabulating mechanisms are enclosed by a casing.

Fig. 11 shows a partial plan view of the machine according to Fig. 10.

Fig. 12 shows in perspective details of the tabulating device according to Fig. 10 viewed from the front left-hand side of the machine.

Fig. 13 shows in perspective a detail of Fig. 12, in which view the detail parts are illustrated in a condition separated from one another.

Fig. 14 shows in perspective a further detail of Fig. 12, whereby different parts are represented drawn out from one another.

Fig. 15 shows a pespective illustration of parts of the shift mechanism and the comma-skipping mechanism.

Fig. 16 shows a plan of a part of a Mercedes Addelektra Typewriting-Calculating machine in which parts of the mechanism according to the invention are incorporated, and in which individual parts are shown broken off in order to expose other parts.

Fig. 17 shows a plan of a part of the mechanism according to Fig. 16 on an enlarged scale.

Fig. 18 shows a side elevation according to Fig. 17, in which for the purposes of better illustration some parts are broken off, and other parts are indicated in section according to the line 18—18 of Fig. 16 viewed in the arrow direction A.

Fig. 19 shows a perspective illustration of a detail of Fig. 18 viewed from the right-hand in front of the machine.

Fig. 20 shows a detail of the mechanism, according to the invention in section according to

the line 18—18 of Fig. 16 viewed in the arrow direction A.

Fig. 21 shows likewise a detail of the invention in section according to the line 21—21 of Fig. 16 viewed in the arrow direction A.

Fig. 22 shows a side elevation of one of the control elements of the subject of the invention.

Fig. 23 shows a perspective elevation of the parts represented in Fig. 22 viewed from the left-hand in front of the machine.

Fig. 24 shows a perspective elevation of further control elements of the subject of the invention likewise seen from the left-hand in front of the machine in which view for better illustration individual parts are illustrated drawn out from one another.

Fig. 25 shows a detail according to Fig. 24, in section.

Fig. 26 shows further control parts of the present mechanism viewed in perspective elevation from the left-hand in front of the machine.

Figs. 27, 28 and 29 shows a plan of a detail of the invention in different positions.

Fig. 30 shows parts of the mechanism according to Fig. 27 in perspective elevation viewed from the right-hand at the rear of the machine.

Fig. 31 shows a plan of parts of the mechanism according to Figs. 27 and 28.

Fig. 32 shows a part of a card for a card bookkeeping system on which entries are examined with the assistance of the present mechanism.

Figs. 33 to 36 show diagrammatically the different positions of the paper carriage, cards and of the symbol-producing and symbol-sensing mechanism.

Figs. 37 and 38 show diagrammatically the bookkeeping cards in the different positions during the working operations determined by the registrations.

Fig. 39 shows the key for a perforation assembly for the numbers "0" to "9" perforated by way of example with four perforating punches.

Fig. 40 shows a shift diagram in relation to the control elements for the mechanism according to the invention.

Figs. 41 and 42 show the known carriage return in perspective.

For the sake of better understanding of the present invention it seems advisable to briefly set forth:

1. Total-taking.
2. Tabulating device.
3. Comma-skipping device.
4. Carriage return-mechanism.

Total taking

The clearing of a value for instance 184.30. calculated and registered in the cross footer CT and the transmission into one of the totalizers T1 to T6 (Figs. 1, 10, 15, 21 and 23) takes place automatically in a manner hereinafter described.

On the depression of the total taking key 1 (Figs. 8 and 16) for the cross footer CT (Figs. 1, 10, 16 and 18) the face 2 (Fig. 7) of the lever 3 acts on the nose 4 (Figs. 1, 2, 5, and 7) of the flap 5 and swings this in the clockwise direction against the action of the spring 6 (Fig. 2). The lug 7 (Figs. 2 and 3) of the flap 5 thereby slides off the edge 8 of the bearing 9 which is formed as a stop 10, whereby the levers 11, 12, 13 (Figs. 2, 3 and 4) rigidly mounted on the shaft 14 and the three-armed lever 15 follow the pull of the spring 16 engaging with the three-armed lever 15.

Through the resulting swinging out of the lever 15 in the clockwise direction is closed the coupling 17 and 18 (Figs. 2 and 3), whereby the cams 19, 20, 21 participate in the rotation of the shaft 22 in the arrow direction 23. The depressed key 1 for total taking of the cross footer CT is hereby held automatictlly so long in the depressed position until the cross footer CT is cleared whereby the coupling 17, 18 for the cams 19, 20, 21 also remains closed for this period.

When, consequently, the shaft 22 (Figs. 1, 2, 3) and therewith the cam element 19, 20, 21 are rotated in the arrow direction 23 the cam 19 acts first on the arm 24 of the lever 15 and swings this in the opposite direction to the arrow 25 against the action of its spring 16, whereby the parts 13, 14, 11, 12 and 5 swing in the clockwise direction while the locking flap 26 at this point is still held in its out-swung position in the anti-clockwise direction by the lock 26, 27.

On the swinging of the flap 5 (Fig. 3) in the clockwise direction its nose 4, however, slides along on the face 2 (Fig. 7) of the T. C. key lever 3, whereby the lug 7 (Fig. 3) of the flap 5 cannot be gripped by the lug 10 of the support 9. Consequently the parts 13, 11, 12, 5 (Fig. 3) are not stopped at the end of their swinging movement in the clockwise direction, but in the further rotation of the cam 19 follow the action of the tensioned spring 16 and 28 so that the lever 15 is therefore swung in the arrow direction 25 (Figs. 2 and 3) again and the parts 13, 11, 12, 5 swing again in the anti-clockwise direction, whereby the tension of the springs 16 and 28 is decreased.

If now shortly before the completion of the first revolution of the cam element 19, 20, 21 (Figs. 1, 2 and 3) that is, shortly before the completion of the calculating process in the hundreds denomination the lever 29 swings round the shaft 30 against the action of the spring 31, by the co-operation of its arm 32 with the curved projection 33 of the cam disc 21 the lock 26, 27 is released. Since, however, at this moment the parts 13, 14, 11, 12, 5, have been swung so far in the anti-clockwise direction under the action of the spring 16 engaging with the lever 15 that the pins 34 (Fig. 4) and 35 (Figs. 2 and 3) lie on the locking flap 36 (Figs. 2, 3, 5, 7) held up to this point by the lever 29 in the locking position so these parts are held by their pins 34 (Fig. 4) and 35 (Fig. 3) until the lever 29 (Figs. 2 and 3) snap with its nose 37 again behind the lug 26. Since according to the foregoing the parts 15, 13, 11, 14, 12, 5, have been brought again by means of the spring 16 into the working position, the nose 38 of the arm 39 of the lever 15 has moved again out, of the working position in relation to the nose 40 (Figs. 2 and 3) of the coupling pawl 17, whereby the cam element 19, 20, 21 after the resulting revolution is not uncoupled but a further revolution of the same and consequently a new calculating process begins previous to which as hereinafter described, a carriage step has taken place so that the cross footer CT is then located with its tens denomination in the calculating position.

This working process is repeated in each denomination of the cross footer CT so that the T. C. key, therefore according to the foregoing, is automatically held depressed until the cross footer CT has been cleared.

After, therefore, having set forth the locking of the T. C. key in its depressed position, the operations which further take place on the depression of the T. C. key will be described.

The key lever 3 (Fig. 7) acts, further on depression with its face 41 on the face 42 of the slide 43 so that the same travels upwards in the op-

posite direction of the arrow 44 against the action of its spring 45. It thereby acts with its pin 46 on the incline 47 of the slot 48 of the slide 49, whereby this is displaced to the left (seen in Fig. 7).

If now it should be inadvertently omitted to shift the cross footer CT for subtraction while the pre-setting plate 50 (Figs. 1, 10 and 18) of the column totalizer concerned has not been set, this is not disadvantageous since when the slide 49 (Fig. 7) travels to the left, the same acts on the pin 51 fixed to the lever 52 and rotates the lever 52, the shaft 53, and the levers 54 and 55, in the anti-clockwise direction, so that the driving wheel 56 is changed over by means of the change over gear 57, 58, 59 and shaft 60, 62, 63 automatically for substractive operation.

On the travel of the slide 49 (Fig. 7) to the left the nose 61 of the part 62 of the slide 49 is laid in front of the face 63 of the aligning tooth 64 of the cross footer CT so that the aligning tooth 64 with its tooth 65 is held in engagement with the four toothed wheels 66 (Figs. 1, 10 and 18) of the cross footer CT lying to the left of the driving wheel 56 (Fig. 8) and lock this wheel. The wheels 66 of the cross footer CT thereby correspond to the wheels 67 (Figs. 1, 10 and 18) of the column totalizers.

Further in the upward movement of the slide 43 (Fig. 7) the part 68 has been carried upward along with it. This hereby released the pin 69 of the lever 70, so that this follows under the action of its spring 71, the part 68 in its movement. Moreover, the coupling lever 72 jointed to the lever 70 moves so that its nose 73 lies over the nose 74 of the draw lever 75.

In the rotation of the three cams 19 (Figs. 2 and 3) 20 and 21 the roller 77 on the lever 76, first slides under the action of the spring 78 engaging with the rod 79 from the elevated part 33 of the cam 21 on the lower part of the same, whereby the draw bar 79 moves in the direction of the arrow 44. Hereby, the toothed wheel 80 (Fig. 5) is brought into engagement with the teeth 81 of the calculating sector 82 by way of the above described parts 83 (Fig. 5), 84, 85, 86, 87 and 88. Further, on the displacement of the draw bar 79 (Figs. 3 and 5) in the direction of the arrow 44 the shaft 89, and the parts 90, 92, 93 (Figure 5) 94, 95, 96 (Fig. 9) and 97 rigidly connected to it are swung by way of the parts 83, 84, 85 (Fig. 5) in the clockwise direction (seen in Fig. 5) whereby by means of the release finger 95, the locking lever 98 lying opposite to it, is raised and accordingly the calculating place located in the working position of the column totalizer is unlocked.

In the swinging movement of the shaft 89 in the clockwise direction (Fig. 9) the lever 97 fixed to it, is likewise swung in the same direction. In virtue of this, the lever 97 acts, by means of its nose 99, on the lever 100, whereby the latter is swung in the clockwise direction. The lever 101 which is in articulated connection with the lever 100, is hereby swung in the anti-clockwise direction against the action of its spring 102 in which swinging movement the shaft 103 and the lever 63, as well as the release finger 105 participate, whereby the driving wheel 56 (Fig. 7) is unlocked, and the toothed wheel 66 located in the cross footer CT is released.

In the further rotation of the three cams 19 (Figs. 2 and 3) 20, 21 the roller 106, rotatably mounted on the lever 107 moves from the elevated part of the cam 19, on to the lower of the same. In virtue of this, the draw bar 108 (Fig. 5) is displaced in the direction of the arrow 44 under the action of its spring 109. The incline 110, of the slot 111 of the rod 108, hereby acts on the roller 112 of the calculating sector 82, whereby this is swung in the anti-clockwise direction. Since the teeth 81 of the calculating sector 82 are in engagement with the toothed wheel 80, so the driving wheel 56 (Fig. 7) of the cross footer CT is rotated in the subtractive direction, by way of the parts 113, 57 (Fig. 8) 58, 59, 60 (Figs. 7 and 8) and until the number roller of the hundreds place of the cross footer CT, which shows a "1" has moved from "1" to "0" in which case, a further rotation of this number roller is not possible since the wheel 66 (Figs. 1, 10 and 18) of the next higher decimal place (thousands place) is held fast by the aligning tooth 64 (Fig. 7), which is locked by the nose 61 (Fig. 7) of the slide 49. The calculating segment 82 (Fig. 5) will be able, therefore, only to rotate through one unit. Accordingly the driving wheel 114 is also rotated. by way of the parts 113, 115, 116, 117, likewise only through one unit whereby in the hundreds decimal place of the corresponding column totalizer a "1" is registered.

Since the segment 82 (Fig. 5) is rigidly connected to the shaft 125, by means of the clamping device 126, this shaft participates in the rotational movement in the direction of the arrow 127. The feeler fingers 128 rigidly mounted on the shaft 125 and designed for the values "0" to "9" are thereby swung together in the anti-clockwise direction and so far until the feeler finger 128 corresponding to the value "1" strikes on the pin 129 of the stop piece 130, which has been swung upwards by depression of the calculating key lever 122, corresponding to the value "1".

By the swinging out movement of the calculating segment 82 (Figs. 5 and 26) through one unit, the lower arm 118 of this segment 82 and the arm 131 rigidly mounted on the shaft 125 participate in the swinging movement of the feeler fingers 128 (or of the calculating sector 82, 118). Accordingly the frame 119, 120, 121 jointed at the points 132 and 133 and guided on the slide bars 134 and 135 by means of screws 136 and 137, will slide forward through an amount corresponding to the value "1." The lower edge 138 (Fig. 5) of the front bridge 120, thereby reaches a position over the nose 139 (Figs. 1 and 5) of the number key 104, corresponding to the value "1."

Shortly, thereafter, the roller 123 (Fig. 3) which is mounted on the lever 124 rigidly connected with the shaft 141 (Figs. 3 and 5) falls into the depression of the cam 20 whereby the arms 134 and 135 rigidly connected to the shaft 141 are swung in the clockwise direction by the springs 142 engaging with their short arms 143 and 144, and with them also the frame 119, 120, 121 guided by them. This frame thereby strikes on the nose 139 (Fig. 5) of the number typing key lever 104, corresponding to the value "1" and presses this lever 104 downwards against the action of its spring 145 (Figs. 1 and 18). The control tooth 146 of the draw-hook 147, is moved by the coupling lever 148 into engagement with the cam shaft. This now draws the draw-hook 147 forward, which by way of the intermediate lever 150, causes the type lever 151 to strike on the platen 152, whereby during the striking movement the control tooth 146 moves out of engagement with the cam shaft 149. Through the striking movement of the type lever 151, the paper carriage has been moved by way of the parts 153

to 157 (Figs. 1 and 18) and one step to the left under the pull of the carriage draw-spring (not shown) so that the next lower place of the column totalizer now lies opposite to the main driving wheel 114 (Fig. 5).

Before, however, the carriage shift takes place the slide 79 (Fig. 5) has moved upwards again and has effected the various locking operation again.

As soon as the paper carriage 140 (Figs. 1, 10, 16 and 18) has moved so that the tens decimal place of the corresponding column totalizer and of the cross footer CT have arrived in the working position, the operations, since the key 1 (Fig. 7) is held depressed, are repeated, whereby the number roller of the cross footer CT, showing an "8" is moved to zero while in the tens decimal place of the column totalizer an "8" appears, whereby the number "3" has been typed, the paper carriage 140 again moves one step to the left.

Consequently, the units decimal place of the column totalizer and of the cross footer CT are in the working position in which the operations are again repeated. After the clearing of the units decimal place has been completed the paper carriage 140 is moved one step to the left by means of the space key 310, whereby the tenths decimal place of the column totalizer and of the cross footer CT, has arrived in the working position.

Now, the same operations are repeated in the tenths decimal place of the column totalizer and of the cross footer CT as the key 1 is still held depressed—whereby the tenths decimal place of the cross footer CT moves to zero, and in the tenths decimal place of the column totalizer a "3" is visible.

When in the manner already described, the column totalizer and the cross footer CT, are now moved so that their hundredths decimal place are in the working position and the Zero is typed on the paper, a further carriage step follows.

Accordingly the column totalizer now stands in such a position that the nose 158 (Fig. 6) of the lever 159 lies in the gap 160 formed by the bars 159 of the column totalizer which was in an operative position and the next column totalizer. The lever 161 could therefore, in consequence of the pull of the spring 162 on the rod 163, swing out in the clockwise direction and the rod 163 could move downwards. The pin 164 of the rod 163 thereby presses on the member 165, whereby the rod 166 is also moved downwards. The lever 167 is thereby swung in the anti-clockwise direction, whereby the lug 168 of the lever 167 is laid in front of the nose 169 of the lever 170 and accordingly a rocking movement of the lever 170 and of the shaft 141 in the clockwise direction is not possible. In consequence of this the arms 134 and 135 fixed on the shaft 141 (Fig. 5) cannot be swung. A downward movement of the figure key striking bar 120 cannot therefore take place. In this case, therefore, the lock 90, 171 would be superfluous. On the other hand, it must, however, be present in order to provide a lock in the comma place, in which case the parts controlled by the totalizer bar 159 (Fig. 6) take up the position according to Fig. 6 in which a locking of the lever 170 is not effected.

By swinging of the lever 167 (Fig. 6) in the anti-clockwise direction round the screw 172 the nose 173 of the lever 167 moves into the working position in relation to the bend 174 of the flap 5.

If now in the rotation of the cam element 19, 20, 21 the lever 15 (Fig. 3) is swung in the opposite direction to that of the arrow 25 round the shaft 30 by the cam 19, whereby the parts 13, 11, 14, 12 swing in the clockwise direction so that at the end of this movement the nose 173 (Fig. 6) of the lever 167 is laid against the bend 175 of the flap 5 and holds this stationary together with the parts 12, 11, 14, 13 in this position. The nose 38 of the lever 15 (Fig. 3) thereby stands in the working position in relation to the stop 40 of the coupling pawl 17. When shortly before the termination of the revolution of the cam element 19, 20, 21 the cam 21 acts on the lever 29 and swings this against the action of the spring 31, the stop angle 26 of the locking flap is released, so that the latter under the action of the springs 28 which have been tensioned by the swinging of the parts 13, 11, 14, 12 is swung back in the clockwise direction on the shaft 14. In virtue of this the nose 3′ (Fig. 7) of the lever 3 is released from the bend 176 of the flap 36 so that the T. C. key lever 3 can return into its rest position under the influence of the spring 45 (Fig. 7). Consequently, the flap 5 also returns into its initial position under the action of the spring 6 (Fig. 3) whereby the lug 7 of the flap 5 can be again laid against the lug 10 of the support 9, since the face 2 (Fig. 7) of the T. C. key lever 3, which in the meantime has been raised, does not prevent this any longer. At the end of the revolution of the cam element 19, 20, 21, the stop 40 (Fig. 3) of the coupling pawl 17 is held by the nose 38 of the lever 15 whereby the coupling 17, 18 (Fig. 3) is raised and consequently the rotation of the cam element 19, 20, 21 is interrupted.

Consequently a totalizer on the machine is therefore at times automatically cleared at one operation whereby the T. C. key 3 during the clearing is automatically held depressed and after the completion of the total taking is again automatically released.

By the release of the key 3 (Fig. 7) the slide 43 is returned under the action of its spring 45, in the direction of the arrow 44 into its rest position again, whereby the part 63 rigidly mounted on it acts on the pin 69 of the lever 70 and swings the same round the shaft 177 in the clockwise direction against the action of its spring 71. The driving lever 72 which is arranged on the key lever 70 and is one the depression of the key 1 has snapped over the nose 74 of the draw lever 75 takes the draw lever 75 along with it, and swings it in the clockwise direction against the action of its spring 178, whereby the pawl 179 engages with the continually rotating cam-shaft 149. The draw lever 75 is thereby carried along and thus swings the intermediate lever 180 in the clockwise direction round its pivot 181.

Consequently the type lever 182 is also swung round its pivot 183, whereby the clear sign "*" is impressed on the paper behind the number "184.30." The mechanism belonging to the sign printing return thereafter into their normal position illustrated in Figure 7.

Tabulating device

For the sake of a better understanding of the present invention, it seems advisable to briefly set forth the operation of the tabulating device.

If one of the column totalizers T1 to T6 (Figs. 1, 10, 16 and 18) is to be brought with a certain denomination into the calculating position, the

tabulator key 185 (Figs. 10, 11, 12, 16 and 18) of the denomination tabulator corresponding to this denomination is depressed, whereby the carriage 140 is released in a manner to be later described, and is moved to the left until the totalizer concerned which is fixed to the carrying rail 186, is brought into the calculating position through striking of the pre-set rider 187, correspondingly arranged to this totalizer on the rider shaft 188, against the column selecting lever 189 (Figs. 1, 10, 11, 12, 14 and 18) corresponding to the depressed tabulator key 185.

On the depression of a tabulator key 185 (Figs. 1, 10, 16 and 18) of the denomination tabulator, the tabulator key lever 190 is moved in the arrow direction "191" round the shaft 192 (Figs. 10, 11 and 12) whereby the associated column selecting lever 189 is raised. The locking yoke 193 (Figs. 10, 11 and 12) thereby moves out of the upper stop 194 of the column selecting lever 189, which is possible within difficulty, in consequence of the spring 195, which engages with the arm 196, of the locking yoke 193. In consequence of this arrangement, however, the locking yoke 193 is capable of entering automatically into the lower stop 194 of the column selecting lever 189, whereby the same is held in its upper position so that the tabulator key 185 on raising of the finger from the key remains consequently in its depressed position, and by the entrance of its key lever 190 into the known roller lock 197 (Figs. 2, 10 and 11) locks all the calculating keys 198 (Figs. 1, 2, 3, 5, 10, 11, 16 and 18) and tabulator keys 185.

By the depression of the tabulator key 185, however, the shift bridge 199 (Figs. 10, 11 and 12) positioned under the tabulator key levers 190, has likewise been swung in the arrow direction 191 round the bearing points 200 and 201.

The arm 202 (Figs. 10, 11 and 12) which engages with its roller 203 under the arm 204 of the auxiliary lever 205 thereby transmits the movement to the auxiliary lever 205 which is swung in the arrow direction 191 around the bearing bar 206. The auxiliary lever 205 thereby enters with its nose 207 into the usual roller lock 208 (Figs. 10 and 11), whereby all the typing keys 209 (Figs. 1, 10, 16 and 18) are locked against depression so long as the tabulator key 185 concerned remains in its depressed position. By the swinging movement of the auxiliary lever 205 the lever 210 is swung round its pivot 211 in the clockwise direction by means of the pin 212 which projects into the slot 213 of the auxiliary lever 205. The arm 214 of the lever 210 is thereby drawn away from beneath the nose 215 of the pawl 216. The pawl 216 now swings under the action of the compression spring 217 in the clockwise direction round its bearing pin 218 fixed in the cam 220, whereby the nose 219 of the pawl 216 is laid into the space standing opposite to it of the rotating cam shaft 149 (Figs. 10, 11 and 12). The cam 220 is therefore rotated in the clockwise direction along with the continually rotating shaft 149, until the latter is connected from the cam shaft 149 as follows:

On the movement of the auxiliary lever 205 (Figs. 10, 11 and 12) in the arrow direction 191 the lever 221 is swung in the clockwise direction round its bearing point 222 against the periphery of the cam 220 by the pin-slot connection 223, 224, whereby the nose 224' of the lever 221 moves into the range of the nose 215 of the pawl 216. If according to the foregoing a rotation of the cam 220 results in the arrow direction 191 the rotation of the same is interrupted after one half-revolution by the striking of the nose 215 of the pawl 216 against the nose 224'' of the lever 221 lying in its path of movement, whereby the nose 219 is brought out of engagement with the cam shaft 149. In the rotation of the cam 220 which is mounted eccentrically to the cam shaft 149, this cam slides with its periphery over the roller 225 mounted on the arm 226 of the lever 227, and swings the lever 227 in the clockwise direction round its bearing pin 228. The levers 229 and 230 fixed to the shaft 231 are swung by way of the rod 232 also in the same direction. Consequently, the angle lever 233 is swung by way of the pin and slot connection 234, 235 in the anti-clockwise direction against the action of its spring 235 (Figs. 10 and 12), whereby its arm 237 (Fig. 13) acts on the nose 238 of the lever 239. This is now swung with its bearing member 240 and the shaft 241 in the arrow direction 242 (Figs. 10, 11, 12 and 13).

During this swinging movement of the lever 239 in the arrow direction 242 the pin 243 (Figs. 10, 11, 12 and 13) fixed thereto slides away from the nose 244 of the locking lever 245, whereon the lever 245 under the action of its spring 246 is laid with its edge 247 in front of the pin 243 of the lever 239. The lever 239, together with the shaft 241 and all the parts fixed to the latter are thereby held in their swung position.

Even without the lock 243, 245 the parts 239, 240 together with the shaft 241 are held in their swung position by the cam 220, which, as the tabulator key lever 185 remains in its depressed position, is held after one-half revolution so that rods 227, 229, 230, 233 and therewith the lever 239 are held positively in their swung position until the tabulator key lever 190 can again move upwards, which as will be evident later will occur when the rider 187 (Fig. 10) located on the carriage 140, runs against the raised column selecting lever 189.

The shift lever 248 (Figs. 10, 11 and 12) fixed on the shaft 241, has naturally been swung in the arrow direction 242 along with the lever 239, 240. The shift lever 248 presses in its turn on the nose 249 (Fig. 15) of the lever 250 fixed on the shaft 251 which latter lever on its part acts with the part 252 screwed to its lug 253, on the arm 254 of the angle lever 255 and swings the latter in the clockwise direction round the bearing screw 256. The arm 257 of the angle lever 255 thereby presses against the nose 258 of the shift tooth 259 (Fig. 15) loosely mounted on the shift rocker 260, and by swinging round the bearing screw 261 brings this out of engagement with the shift wheel 262, whereby the carriage movement to the left takes place.

The shift lever 263 (Fig. 14) fixed on the shaft 241 was likewise swung in the arrow direction 242, whereby the pin 264 of the arm 265 of the lever 263 takes along with it the locking bridge 266 (Figs. 10, 12 and 14) together with its locking bar 193 against the action of the spring 195 by striking on the arm 196. The second locking bridge 267 (Figs. 10, 11, 12 and 14) arranged loosely on the shaft 241 is carried along in the same direction by means of the spring 268 which is connected on the one hand to the pin 269 of the bridge 267 and on the other hand to the lug 270 of the lever 263. In the swinging of the shaft 241 in the arrow direction 242 the locking bar 193 acting only on the raising of the column selecting lever 189 is therefore moved out of the working position in relation to the same, whilst the other locking bridge 267 moves into the work-

ing position in relation to the column selecting lever 189 and takes over the holding of the same by entering into the lower stop 271 (Fig. 12).

According to the foregoing, however, the paper carriage 140 has been released for a movement towards the left, in which the carriage movement is braked by a tabulator brake, not illustrated, which on the swinging of the lever 272 (Fig. 12) in the arrow direction 242 is brought into the working position by the curved slot connection 273, 274, by way of the lever 275 actuated thereby.

In the said movement of the carriage 140 to the left the rider 187 arranged on the rider shaft 188 of the carriage 140 correspondingly to the totalizer moving into the working position strikes on the raised column selecting lever 189 (Figs. 1, 10, 11, 12, 14 and 18) corresponding to the depressed tabulator key 185. All the column selecting levers 189 mounted between the lever 263 (Fig. 12) and the adjusting collar 276 (Fig. 11) together with the shaft 241 and all the parts fastened thereon are thereby displaced in the arrow direction 277 (Figs. 11, 12 and 13) against the action of the spring 278.

In this displacement the lever 239 (Fig. 12) through being displaced along with the bearing piece 240 strikes with its nose 279'' on the pin 279 (Figs. 11, 12 and 13) fixed to the bearing rail and is swung first of all in the arrow direction 280 round the bearing screw 281 against the action of the spring 282.

The pin 243 (Fig. 13) which under the influence of the spring 283 has been laid against the edge 247 of the lever 245 (Figs. 10, 12 and 13) now moves in a lateral direction out of the range of the locking lever 245, so that the lever 239 and its bearing 240, together with the shaft 241 and all the parts attached to the latter, are now swung back by the spring 283 in the opposite direction to the arrow direction 242 (Figs. 10, 12 and 13) into their rest position, whereby the locking bridge 267 releases again the column selecting lever 189 which up to this point has been held fast.

Since, however, at this moment the locking bridge 193 (Fig. 12) swings likewise in the opposite direction of the arrow 242 under the action of its spring 195, it could happen that the same engages in the lower stop 194 of the column selecting lever 189 before this could move downwards. In order to prevent this undesired occurrence, the inclined nose 284 (Figs. 11 and 12) is provided on the part 285 on which runs up the arm 286 of the locking bridge 193, so that the locking bridge 193 is at first prevented from performing a swinging movement in the opposite direction of the arrow 242. Meanwhile, however, by the displacement of the shaft 241 in the arrow direction 277 the lever 248 (Fig. 12) fixed on the shaft 241 has slid away from the nose 249 (Fig. 15) of the part 250 so that the parts 250, 255 were released and consequently the loose shift tooth 259 could engage with the shift wheel 262, whereby this now takes over the holding of the carriage 140. This follows simultaneously with the swinging of the shaft 241 in the opposite direction of the arrow 242, i. e., at the instant when the pin 243 leaves the locking lever 245 in the arrow direction 277.

As soon as the column selecting lever 189 under the action of the tabulator key lever spring, not illustrated, has moved downwards the bridge 199 and the auxiliary lever 205 were brought back into their rest position by means of the spring 287 (Figs. 10 and 12) engaging with the auxiliary lever 205, whereby the nose 224'' of the angle lever 221 releases the coupling pawl 216, which up to this point was held fast, and swings the nose 214 of the lever 210 again in to the rotational path of the coupling pawl 216 so that the disc 220 performs its second half-revolution after which it comes to a stand still again as the nose 215 of the coupling pawl 216 runs up on the nose 214 of lever 210. During this half-revolution the rods 227, 232, 229, 230, have arrived again in their rest position by means of the spring 236 engaging with the lever 233.

The releasing conditions of the raised column selecting lever 189 are different with short carriage paths than with long carriage paths, i. e., with short carriage paths the releasing movement proceeds more slowly than with long carriage paths, in which the carriage in spite of the breaking action through the tabulator brake still possesses relatively great inertia. Consequently, the coupling commences its second half-revolution earlier with long carriage paths than with the short carriage paths.

The result of this is that the swinging of the shaft 241 in the opposite direction of the arrow 242 occurs too early and accordingly the loose shift tooth 259 engages too early with the shift wheel 262, so that when, for example, it is desired to tabulate in the units denomination without the provision of special means the carriage 140 would yet stop in the tens denomination.

This disadvantage is avoided by the lock 243, 245 (Fig. 13) which does not permit a swinging of the shaft 241 in the opposite direction of the arrow 242 before the pin 243 has left the lever 245 laterally.

After the pin 243 (Figs. 12 and 13) has moved out of engagement laterally with the lever 245 and the column selecting lever 189 has taken up its lower position again, the shaft 241 moves back in the opposite direction of the arrow 277 into its rest position under the action of the spring 278 (Fig. 12) and accordingly also the lever 239 (Fig. 13). Simultaneously with this movement the locking yoke 193 (Fig. 13) swings again into its locking position in relation to the column selecting lever 189 while the locking yoke 267 was swung earlier out of its locking position through the action of the lug 270 (Fig. 14) of the lever 263 on the nose 288 of the locking yoke 267.

The object of the locking yoke 267 is to hold the column selecting lever 189 in its raised position until the pin 243 (Fig. 13) is swung laterally out of the locking lever 245, while the locking yoke 193 (Fig. 14) is still held by the control curve 284 (Figs. 11 and 12) of the lever 285 out of the locking position in relation to the column selecting lever 189 during the return movement of the shaft 241 in the opposite direction of the arrow 277.

Comma skipping device

As soon as one of the column totalisers T1 to T6 is located with its units denomination in the working position the pawl 290 (Figs. 1 and 15) is somewhat less than one denomination distant from the set rider 291, i. e., it is located somewhat less than a denomination to the left of the rider 291. By the carriage step released in the units denomination the rider 291 moves within the working range of the pawl 290. Since this acts thereby on the nose 292 (Fig. 15) of the lever 293, the lever 293 is swung around the screw 294 in the clockwise direction, whereby the arm 295 of the lever 293 acts on the rocker

260 and swings the same around its centre points (not illustrated) in the anti-clockwise direction, i. e., the loose escapement tooth 259 which is lifted out of engagement with the escapement wheel 262, is lifted immediately a second time out of engagement with the escapement wheel 262. During this lifting-out movement the rider 291 has already released the pawl 290 again so that the escapement rocker 260 can return into its rest position under the action of the spring 296. The fixed escapement tooth 298 (Fig. 15) thereby released the escapement wheel 262 which is again moved a step further which is limited by the falling-in of the loose escapement tooth 259. On the swinging back of the rocker 260 into its rest position under the action of the spring 296 the rocker 260 acts on the arm 295 of the lever 293 and swings the same round the screw 294 back into its rest position which is determined by the limb 299 of the lever 293 striking on the pin 301 arranged on the part 300 (Figs. 1 and 15) of the frame. The comma position has therefore been automatically skipped and consequently the totaliser stands in the tenths denomination.

Carriage return

If the carriage return key indicated by "CR" (Figs. 41 and 42) is depressed, the key lever A which is connected with the slide B causes a downward movement of the same, whereby the lever C. D. is swung round its pivot E in the anticlockwise direction so that the nose F of the lever C. D. acts upwards against the projection G of the flap H, whereby the flap is swung up and releases the nose I (Fig. 41), of the lever K, so that the lever K moves in the opposite direction to the indicated arrow direction "A." The lever L is thereby swung round its pivot M (Fig. 42) in the anticlockwise direction, whereby the lever N brings the coupling half O into engagement with the coupling half P and, insofar as the coupling Q. R. is closed, rotates the toothed wheel *Aa*, which is continually in engagement with the rack *Ab* in the arrow direction *x*, by way of the toothed wheel S the spur wheel T the spur wheels U and V the bevel wheel Z which is rigidly mounted on the shaft Y. The rack *Ab* is thereby displaced to the right by the amount determined by the pin slot connections *Ac*, *Ad*.

After the movement of the rack *Ab* to the right, relatively to the carriage frame 305, is terminated by the left-hand end of the slots *Ac* striking against the screws *Ad*, the carriage 140 is taken along by the rack *Ab* by means of the screws *Ad* in the further rotation of the toothed wheel *Aa*, whereby the carriage is likewise forwarded to the right, i. e., is returned.

Towards the end of the carriage return movement the left-hand margin setter *Af* (Fig. 16) runs against the stop *Ah* arranged on the bar *Ag* (Fig. 41) and brings the bar *Ag* and the parts co-operating with it back into their illustrated rest position, whereby the coupling P. O. is again opened and the carriage return movement interrupted.

General mechanism

On the rails 303 and 304 fixed to the machine frame 302 (Figs. 1, 10 and 18) the paper carriage 140 already mentioned together with its platen 152 is arranged. On the front bridge of the carriage frame 305 of the paper carriage 140 is fixed a supporting rail carrying the column totalizers T1 to T6. On a table 307 attached to the calculating mechanism housing 306 is displaceably arranged a prism bar 308, which carries a cross footer *Ct*. In front of the calculating mechanism 306 are located the figure typing keys 309 the letter typing keys 209 the space key 310 the decimal calculator keys 185 and the calculating keys 198. To the left of the calculating keys 198 (Fig. 16) is arranged the "TT" key and to the right of the calculating keys 198 the TC key 1. Further on the left of the letter typing keys 209 the carriage return key "CR" (Fig. 41) is located and to the right of the letter typing keys 209 the case-shift or type-shift key "SK" and the key "PS" for continuous type-shift. These parts and their arrangements are sufficiently known, and are here only shortly described for the completion of the description.

Value punching mechanism

On the side parts 311 and 312 (Figs. 16, 18, 27, 28 and 29) of the case shift frame carrying the platen 152 of the paper carriage 140 are fixed two supporting plates 313 and 314 by means of screws 315 and 316 (Fig. 18). Into the supporting plates 314 and 315, two tubular shafts 317 and 318 (Figs. 16, 18, 20, 27, 28 and 29) are riveted, so that they form together with the supporting plate 313 and 314 a rigid frame. Two bearer members 319 and 320 are combined by means of screws 321 and 322 (Figs. 16 and 31) to a unit forming a perforator carriage in which guiding-in slot 323 formed on the part 319 serves for the introduction of a record card hereinafter described. On the projection 324 (Fig. 31) 325 and 326 of the part 320 are rotatably mounted coned rollers 330, 331 and 332 (Figs. 18, 20 and 30) by means of screws 327, 328 and 329, the end rollers 330 and 332 being above the tubular shaft 318 and the middle roller 321 below this shaft. Two rollers 333 and 334 are rotatably mounted by means of screws 335 and 336 in the supporting angles 337 and 338 (Fig. 30) which on their part are screwed by means of screws 339 and 340 to the part 319. The parts 319 and 320 are mounted on the tubular shafts 317 and 318 by means of the rollers 330, 332, 333 and 334, so as to be longitudinally moveable thereon, whereby lifting-off of the parts from the shaft 317 is prevented by the roller 331, while lifting off of the parts from the shaft 317 is not possible owing to a guide angle 342 fixed by means of the screws 341 (Figs. 16 and 30) to the part 319 and guided on the shaft 317. On the shaft 317 two collars 343 and 344 (Figs. 30 and 16) are fixed by means of pins 345 and 346 (Fig. 30), while two further collars 347 and 348 are arranged loosely on this shaft. Between the collars 343 and 347 and 344 and 348 compression springs 349 and 350 (Figs. 16 and 17 to 30) are arranged on the shaft 317. If the guide angle 342 is located with its recesses 351 over a pin 352 fixed in the tubular shaft 317 so the collars 347 and 348 are acted upon against the pin 352. The guide angle 342 is thereby held fast between the collars 347 and 348. The rest position of the perforator carriage 319 and 320 is thereby determined. A supporting member of 353 (Figs. 16, 17, 20 and 30) is screwed by means of screws 354 to a part 355 of the bearing member 319. In corresponding recesses in a part 356 of the supporting member 353 cores 357, 358, 359 and 360 (Fig. 30) of magnet coils 361, 362, 363 and 364 are pivotably mounted on a shaft 365 fixed in the part 256 and the armature parts 366, 367, 368 and 369 (Figs. 18, 20 and 30), these cores are capable of co-acting with the supporting member 353 on closure of an

electric circuit. The cores of the coils thereby act with their ends 370, 371, 372 and 373 on the punching pins 374, 375, 376 and 377 (Figs. 16, 18 and 20). The punching pins 375, 375, 376 and 377 are guided in corresponding holes in the perforator carriage part 319 and are acted upon continually towards the magnet coil core parts 370 to 373 by means of compression springs 378, 379, 380 and 381 (Figs. 18, 20 and 30) which are arranged between shoulders 382, 384 and 385 on the punching pins 374 to 377 and corresponding recesses in the perforator carriage part 319 and which are arranged on the punching pins 374 to 377. The coils 361 and 364 are thereby swung out so far in the clockwise direction around the bearing shaft 365 (Figs. 18 and 20) until they strike on the correspondingly bevelled part 356 and hold thereby all the parts acted on by the springs 378 to 381 in the rest position. In a dove-tail groove formed on the part 355 of the supporting member 318 is inserted a correspondingly formed bar 385 (Figs. 16, 18, 20 and 30) which consists of an insulating material and is held against displacement by means of a screw 387 (Fig. 16). A bus bar 388 (Fig. 30) pressed into the rail 386 is capable of co-acting with contact pins 389, 390, 391 and 392 (Figs. 17 and 36). The contact pins 389 to 392 are longitudinally displaceable in small bushes 393, 394, 395 and 396 which are pressed into insulating sleeves 399, 400, 401 and 402 (Figs. 17, 20 and 31). The insulating sleeves 399 to 340 on their part are pressed into corresponding holes of the perforator carriage part 320. By means of contact springs 403, 404, 405, 406, (Figs. 17 and 20) which are fixed on the bearing member 320 between insulating plates 407, 408, 409, 410 and screws 411, 412, 413, 414, the contact pins 389 to 392 are pressed constantly against the bus bar 388. In recesses in the bearing member 320, dies 415, 416. 417 and 418 (Figs. 18, 17 and 20) are fixed, with which the hole punches 374 to 375 already described co-act for the purpose of punching a record card hereinafter described. Further a receptacle 419 (Figs. 16, 18 and 20) is fixed by means of the fixing angles 420 and 421 (Fig. 16) welded to it and by means of screws 422 and 423 to the supporting member 320, which receptacle serves for the reception of the card punchings, which fall into it through corresponding holes 424 (Fig. 20) provided both in the housing 419 as well as in the bearing member 320. To the left-hand side (seen in Fig. 30) a bearing part 425 (Figs. 16, 21 and 30) is fixed to the part 319 by means of a screw 426, and to the upper part 427 of the part 425 a further magnet coil 428 together with its core 429 is guided in a corresponding slot of the part 427 and is swingably mounted on a pivot screw 430 screwed into the latter. The coil core 429 is capable of co-acting by means of its end 431 with a punching pin 432 (Figs. 21 and 31) longitudinally displaceable in a hole of the bearing member 319. A spring 434 which is arranged between a shoulder 433 (Fig. 21) on the punching pin 432 and a corresponding recess in the bearing member 319, and which is arranged on the pin 432 presses the latter constantly against the end 431 of the coil core 429 and swings this together with the coil 428 in the anti-clockwise direction round the pivot screw 430. This swinging movement is limited by the core 428 striking on the bevelled part 427 of the bearing member 425, whereby the rest position of all parts acted on by the spring 434 is determined. This punching pin 432 co-acts with a die 435 fixed in a recess of the perforator carriage part 320, when a hole is to be made in a record card described hereinafter. A receptacle 440 (Figs. 16 and 21) screwed to the bearing member 320 by means of fixing angles 436 and 437 (Fig. 16) and screws 438 and 439 serves for the reception of the card punchings which fall thereinto through holes 441 in the bearing member 320 and in the housing 440 into the latter. On a shaft 444 (Fig. 16) rotatably mounted in projections 442 and 443 (Figs. 16 and 19) of the bearing member 320, is fixed a lever 445 (Figs. 16 and 19) by means of its boss 446 and a pin 447 at the left-hand side of the shaft. By means of a rivet 450 the lever 445 is articulately jointed to the flattened end of a sensing pin 448, which is displaceably mounted, in a corresponding hole of the bearing member 320, for which purpose the sensing pin 448 is provided at the jointing position with a corresponding elongated slot.

At the right-hand side of the shaft 444 a lever boss 452 and a pin 453 to this shaft which lever is jointed by means of a rivet 456 to the flattened end 454 of a sensing pin 455 displaceably mounted in a corresponding hole of the bearing member 320, for which purpose the sensing pin 455 is provided at its jointing position with a corresponding slot. A further lever 457 (Fig. 19) is fixed by means of its boss 451 and a pin 459 likewise at the right-hand side of the shaft 444. By the arrangement of the left-hand lever 445 at the left-hand outer side of the bearing 442 and of the right-hand lever 457 at the right-hand outer side of the bearing 443, the shaft 444 is mounted so as to be non-slidable in the said bearings. On the extreme right-hand end of the shaft 444 a lever 460 is mounted so as to be loosely swingable and is held by means of an adjusting collar 462 fixed by a screw 461 on the shaft 444. The levers 457 and 460 are interconnected with one another by a torsion spring 463 arranged between them on the shaft 444, whereby the spring projects with its one end into a corresponding hole of the lever 457 and with its other end into a similar hole of the lever 460. To an actuating lever 464 (Figs. 16, 18 and 19) for the paper feeding means is articulately jointed by means of a rivet 465 a connecting member 466 which is guided laterly by means of two guide angles 468, screwed to the already described case-shift frame side part 312 by means of two screws 467. A pin 470 riveted into the connecting member 466 projects through a corresponding hole in the lever 460 and thereby connects the lever 460 with the actuating lever 464 by way of the connecting member 466, so that the lever 460 is laterly displaceable in relation to the pin 470 without losing the driving connection of the parts 460 and 470.

A stop angle 471 (Figs. 27 to 31) is fixed at the left-hand side of the perforator carriage parts 319 and 320 by means of screws 472 (Fig. 31). To a bend 473 of the part 471 a locking pawl 474 is pivotally mounted (Figs. 30 and 31) on a screw 475. The locking pawl 474 is held in its position for the time being by friction and is capable of co-operating for a purpose hereinafter described, with a stop 476 arranged on the machine frame. A further stop 477 (Figs. 27, 28, 29, 31) on which the stop angle 471 acts in a manner hereinafter described, is likewise fixed to the machine frame, and acts in the same direction of movement as the stop 476.

Contacts C28, C29 and C30 (Figs. 27 to 28, 33 to 36 and 40) are fixed on a bar of insulating material on the carriage frame and co-acts with an insulated rail C31 fixed to the machine frame.

On each of two further shafts **478** and **479** (Fig. 20) mounted between the two case-shift frame side parts **311** and **312** (Fig. 18) are adjustably mounted two or several forwarding rollers **480** and **481** for the purpose of forwarding the cards. On the end of the shaft **478** projecting from the right hand side part **312** of the paper carriage **140** (Figs. 16 and 20) a roller **482** is rigidly mounted, and is in driving connecnection with a roller **484** arranged on a stub shaft **483** so as to be loosely rotatable thereon. The latter roller **484** again is in driving connection with a roller **486** rigidly mounted on the platen shaft **485**. In this case on rotation of the platen **152** by means of the hand knob **487** the drive is effected to the shaft **478** and its rollers **489** by way of the friction drive **482**, **484**, **486** (Fig. 20), whereby the rollers **481** together with the shaft **479** are spring pressed on to the rollers **480** and thereby participate in the drive.

The shaft **125** (Figs. 18 and 26) is carried out of the left-hand side of the calculating mechanism housing **306** (Figs. 16 and 18). On the projecting end of the shaft **125** is fixed a lever **514** (Figs. 16, 18 and 26) by means of its hub **515** and a pin **516**. To the lower segment-formed end **517** is fixed a metal plate **518** and a plate **519** of insulating material, whereby contact pins **520** fixed in the metal plate project through corresponding holes of the insulating plate **519**. The contact pins **520** are capable of co-acting with the contact springs **521**, **522**, **523** and **524**. The contact pins **521** to **524** are clamped between two plates **525** and **526** (Fig. 18) of insulating material. The plates **525** and **526** are screwed to the machine frame **302** by means of screws **527**. These parts are covered up and protected on the outside by a casing (not illustrated).

The manner of working of the value perforating mechanism shall now be described in the following section "Value punching" by the aid of an example:

Method of operation in value punching

For the description of the method of operation let it be assumed that the entries are to be performed according to the record card **489** partially illustrated in Fig. 32.

It may be remarked to commence with that in the position **464** for the lower paper feed rollers **490** and **491**, these rollers contact with the platen **152**. In this position of the release lever **464** the pins **448** and **445** which sense the edge perforations of the account card are in their inoperative position illustrated in Fig. 19. The account card **489** (Fig. 32) can therefore be freely inserted in the slot **323** (Fig. 31) formed by the parts **319** and **320** of the perforator carriage, until its lower edge as is shown in Fig. 18 lies between the rollers **480** and **481**. The account card **489**, moreover, is introduced with its right-hand edge at a distance t (Fig. 32) from the right-hand edge of the slot **323**, which distance can be indicated by a mark **492** (Fig. 33). By rotating the rotatable knob **489** (Fig. 16) of the platen **152** the rollers **480** and **481** are rotated in the manner described under the section "Value punching mechanism," whereby the account card **489** is carried downwards in the arrow direction **493** (Figs. 18 and 20). Its lower edge is then inserted either by hand or by a correspondingly arranged guide plate laid between the platen **152** and paper guide plate **494** (Figs. 18 and 20), where it is gripped by the front lower feed rollers **491**. By rotating the rotatable knob **487** (Fig. 16) of the platen **152** further, the account card **489** is now forwarded also through the co-operation of the platen **152** with the lower feed rollers **490** and **491**, whereby the velocity generated by the platen **152** in the rollers **480**, **481**, and in the feed rollers **490** and **491**, is naturally so determined that it is the same. The account card **489** is now moved in the arrow direction **493** until it is located with its line **495** indicated in Fig. 32, at the typing level.

Then the name "Herman Müller," place of residence "Hamburg," and account number "32," are typed, in which operation the paper carriage and the perforator carriage are moved together.

After this has been effected the account card **489** is moved upwards by a rotation of the rotatable knob **487** (Fig. 16) so far in the opposite direction to the arrow **493** (Figs. 18 and 20), until the line indicated by **496** in Fig. 32 lies at the typing height. After this has been effected the columns I to VI of the account card **489** are clearly visible, so that now, if this has not already been effected, the totalizers T1 to T6 (Fig. 16) can be sent on and the tabulator riders **187** (Fig. 18) adjusted.

When this has taken place the account No. "375," the date "12.3" and the text "Pay cash account in bare" is typed. Then the paper carriage is brought into the highest denomination of the column II in the manner described under the section "Tabulating device," by pressing on the corresponding tabulator keys, namely the keys "0,01" and "10000."

By striking the corresponding calculating keys **198**, the value "30750,00" is typed in the column II, whereby as known, it is simultaneously registered in the totalizer T2, and in the cross footer CT. It may be remarked at this point that on depression of the calculating keys **198**, substantially the same operations occur as are described under the section "Total-taking," and since this mechanism does not belong to the invention it shall not be further described, since the pre-setting plate **50** (Fig. 18) of the totalizer T2 for the control of the kind of calculation of the cross footer CT is set in this case for addition, the value "30750,00" is registered additively in the cross footer Q. Now, by further tabulating operations the paper carriage **140** is brought with the column VI of the card Y in the typing position.

In this column the value "30750,00" is to be cleared from the cross footer Q, and registered in the totalizer T6.

According to the invention, however, the value "30750,00" during the clearing operation from the cross footer CT, is to be perforated automatically at **497** to **503** (Fig. 32) which is effected as follows:

First, the pawl **474** arranged on the perforator carriage, which now stands opposite to the tooth **504** of the stop **476** (Figs. 27 to 28 and 39 to 36) is brought into engagement with the tooth. It is thereby attained that the perforator carriage **319**, **320**, which up to the present has travelled in common with the paper carriage **140** to the left, now remains stationary in relation to the paper carriage **140** which travels further to the left. Meanwhile in the previous common movement of the paper carriage and the perforator carriage to the left the contact C28 arranged in the paper carriage **140** is moved into the working position in relation to the contact C31, which is rigidly mounted on the machine frame **302**,

This position is shown in Fig. 33. In Fig. 33 the stationary held or stationary parts, namely the stop 476, the perforator carriage 319, 320 (Fig. 27), the contact C31, and the main drive wheel 505 for driving the totalizers T1 to T6 are illustrated in thick lines, while the parts moving to the left and now independent of the perforator carriage 319, 320, namely the paper carriage 140, the account sheet 489, and the totalizers T1 to T6 are represented in thin lines. The account sheet 489 held on the platen 152 by the feed rollers 490, 491 (Fig. 18) and the rollers 480, 481, is now moved on the further travel of the paper carriage 140 to the left in the slot 323 of the perforator carriage 319, 320, and consequently changes its position in relation to the punching pins 374 to 377, at each carriage step, which it can do unimpeded since the pins 448 and 455 (Figs. 16 and 19) are located in the inoperative position.

Now after depression of the corresponding tabulator key, the paper carriage 140 has been brought into the position corresponding to the highest denomination of the value "30750,00" in the manner described under the section "Tabulating device," the total-taking key indicated by TC (Fig. 16) is depressed, whereon the total-taking is effected in the manner described under the section "Total-taking." The value "30750,00" registered in the cross footer CT is thereby automatically cleared denomination by denomination out of the cross footer, and registered in the totalizer T6, located in the working position, whereby it is likewise automatically and simultaneously typed in the column VI of the card 489 (Fig. 32) as a new balance.

In the present mechanism the typed value which in the total-taking is transmitted from one totalizer to the other and simultaneously typed on the card 489 is at the same time punched automatically denomination by denomination in a suitable position, for example, on the left-hand side of the card 489 (Figs. 32 and 37). The punching means, which lie at a determined distance over the position where the type is struck on the platen 152, are so arranged that the value punching takes place between the typing lines of the card (Fig. 32). Since in the present mechanism the numbers "0" to "9" in the value punching are effected not by ten but only by four hole punches, 374, 375, 376 and 377 (Figs. 1 to 17) it is necessary that these four hole punches come into operation in a determined sequence, singly, or by twos in the perforation of a value for the numbers "0" to "9." This actuation of the hole punches is effected according to the key illustrated as a table in Fig. 39. The distance of one punch in relation to the other must also be somewhat greater than the highest placed value to be typed. In the punching operation the following mechanisms are operated:

On the depression of the TC-key 1 (Fig. 16), the insulator member 506 (Fig. 8) arranged on the key lever 3, acts on the spring 507, whereby the part 508 contacts with the part 509 of the spring 510 and consequently the contact 508, 509 (Fig. 40) is closed. It may be remarked at this point that the two springs 508 and 510 are insulated from one another by means of an insulator member 511, and that the parts 507, 510 and 511 are screwed by means of screws 512 to an angle piece 513 of insulating material which again is mounted on the machine frame 1 by means of screws, not illustrated.

The clearing of the value effected in the total-takings results, as described in detail in the section "Total-taking," by toothed segment 82 (Figs. 1 and 26), in which operation the later makes no movement for the number "0," while for the numbers "1 to 9," swings out with the shaft 125 progressively for 9 differently great paths. These swinging movements are transmitted to the segment lever 514.

If, therefore, the first number "3" of the value "30750,00" of the first entry is cleared from the cross footer CT, the toothed segment 82 (Figs. 18 and 26) and with it the segment lever 514 are swung out for an amount corresponding to the number "3", whereby the contact pin 520 corresponding to the number 3, co-acts with the contact spring 523, (Figs. 40 and 26). After the lever 514 has come to rest in this swung-out position after making the contact, the contact C32 (Fig. 40) is closed, by the insulator contact plate 528 arranged on the continually rotating shaft 22 (Figs. 18 and 40), and the contact springs 529 and 530. The circuit now closed takes therefore the path 531, C32, 518, 520, 523, punch magnet 363, C28, C31, 508, 509, 532. This circuit cannot be closed in the short contact connections 520, 521, and 520, 522, effected during the swinging movement of the part 514, since the final closure of the circuit is only effected after the closing of the contact C32, which, according to what has been said previously, is only caused when the segment lever 514 has completed the swinging movement arising in the punching of a number. The magnet coil 363 therefore obtains current, whereby the core 359 (Figs. 16 and 30) with the part 368 is attracted to the part 353 (Figs. 16, 18, 20 and 30). The coil core 359 thereby acts on the shoulder 384 of the punching pin 376 and displaces this against the action of the spring 380 and in the opposite direction to the arrow 533 (Fig. 18) whereby it is pushed through the card 489. A hole 497 (Fig. 37) for the number "3" has therefore been formed in the card 489. The punched-out portions arising from this operation pass through the hole 424, into the receptacle 419, and thus cannot fall into the machine so as to interfere with the mechanism.

The contact plate 528 arranged on the continually rotating shaft 22 has only closed for a short time the contact C32, in order to open it again immediately. The coil core 359 and the punching pin 376 following the strained spring 380 are thereby immediately returned into their initial position so that the punching pin 376 is moved again out of the card 489, when the carriage step follows after typing the number "3", in the column VI of the card 489, cleared from the cross footer CT. The paper carriage 140 with the card 489 is thereby moved for a step to the left, whereby the card 489 is moved in the slot 323 of the perforator carriage 319, 320 (Figs. 16 and 27) which according to what has been said above, is held fast in its position according to Fig. 33. Now the second number "0" of the value "30750,00" is cleared from the cross footer CT, and registered in the totalizer T6. In this operation the contact pins 520 corresponding to the number "0" co-act with the contact springs 521 and 520, and after the contact C32 is closed in the manner hereinbefore described, the following circuit is closed: 531, C32, 518, 520, 521, 522, punching magnets 361 and 362, C28, C31, 508, 509, and 532. The magnet coils 361 and 362 thereby obtain current, whereby the cores 357 and 358 (Fig. 30) are attracted against the action of the springs 378 and 379 in the manner hereinbefore de-

scribed, so that the card obtains a further punching 498 (Fig. 37), which consists of two perforations and corresponds to the number "0". After, as above described, the punching pins 374 and 375 are moved under the action of their springs out of the card 489 again, and the number "0" is typed in the column VI of the card 489, a further carriage step takes place, which brings the card 489 further to the left. The number "7" of the value "30750,00" in the cross footer CT is brought to zero. In the swinging out of the segment lever 514 which thereby takes place, the contact pins 520 corresponding to the number "7" make connection with the contact springs 521 and 524, so that after the contact C32 is closed the current takes the following path: 531, C32, 518, 520, 521, 524, magnet coils 361 and 364, C28, C31, 508, 509 and 532. The cores 537 and 360 (Figs. 17 and 30) of the magnet coils 361 and 364 obtaining the current are swung out, whereby the punching pins 374 and 377 are moved in the opposite direction to the arrow 535 against the action of the swings 378 and 381, and pushed through the card 489.

A further punching 499 (Fig. 37) consisting of two holes corresponding to the number "7" is thereby made in the card 489. This number "7" is now typed in the column VI on the card 489 after the contact C32 has previously been reopened and the punching pins 374 and 377 returned into the initial position under the action of the springs 378 and 381, that is, they are moved out of the card 489. The carriage 140 with the card 489 thereby obtains a further movement to the left of one step. Now the number "5" of the value "30750,00" is cleared from the cross footer CT, whereby the segment lever 514 performs a swinging movement corresponding to this number, and thereby connects the contact pins 520, associated with the number "5", with the contact pins 521 and 523. As soon as the contact C32 is closed, the current takes the path 531, C32, 518, 521, 523, magnet coils 361 and 363, C28, C31, 508, 509, 523. The magnet coils 361 and 363 thereby obtain current, whereby their cores 357 and 359 are attracted and thereby act on the punching pins 374 and 376 so that these are pushed through the card 489 against the action of their springs 378 and 380. The card 489 thereby obtains a new punching 500 (Fig. 37) which consists again of two holes. On the typing of the punched number "5" the carriage with the card 489 is again shifted further through one step after the contact C32 has been previously re-opened, and the punching pins 374 and 376 following the strained springs 378 and 380 are returned into their initial position. Now the next number "0" of the value of "30750,00" is cleared out of the cross footer CT in which operation the same mechanisms are actuated as in the clearing of the foregoing "0" of the value "30750,00". The card 489 thereby obtains a further punching 501 (Fig. 37) which corresponds exactly to the perforation 498 only that it is punched on the card 489 in a position displaced by the corresponding number of carriage steps. The carriage 140, after the "0" is typed in the column VI of the card 489, is located with the comma position of the value "30750,00" of the column VI of the card 489 in the typing position. This position is skipped by the comma-skipping mechanism described in the section "comma-skipping device." No punching is effected in this case on the card 489; it is only shifted for a step further to the left, that is effected by the comma-skipping mechanism hereinbefore described. After this, the two "0's" after the comma are cleared from the cross footer CT, whereby the same mechanisms are actuated as in the case of the zeros already cleared from the cross footer CT. The paper carriage 140 is thereby moved two steps further to the left, while the two zeros after the comma of the value "30750,00" are typed in the column VI of the card 489 and the card obtains two further punches 502 and 503. The punchings 502 and 503 corresponding exactly to the punchings 498 and 501, only that these are punched in the card 489 at corresponding step distance to one another. As soon as the last number of the value "30750,00" is cleared from the cross footer CT, the TC-key 1 is automatically released in the manner described under the title "Total-taking", whereby the switches 508 and 509 are automatically opened again. The opening of the switches 508, 509 after completion of the total taking is necessary, since in the rest position of the segment lever 514 the contact pins 520 corresponding to the number "0" are constantly in connection with the corresponding contact springs 521 and 522. In the event of the switches 508, 509 remaining closed after total-taking has been completed, the punching pins 374 and 375 would be continually operated, since the contact C32 is constantly opened and closed alternately by the continuously rotating shaft 22. It would be possible therefore a punching to be punched on the card 489 corresponding to the number "0" that does not correspond to the value "30750,00" cleared by total-taking from the cross footer CT, so that therefore in the testing described under the title "Sensing device" of the punched value, errors would arise. Since, as hereinbefore described, the perforator carriage 319 and 320 was locked on the arrival of the paper carriage 140 with the column VI of the card 489 in typing position or at the beginning of the total-taking, the spring 350 (Fig. 27) has been tensioned in the carriage movement to the left, during the total-taking, whereby the card 489 following the movement of the paper carriage 140 has moved freely to the left in the slot 323 of the perforator carriage 319, 320. The carriage 140 is now brought by hand into the extreme right-hand position. In this movement to the right the perforator carriage 319, 320 follows first the tensioned spring 350, and returns into its initial position which forms its rest position, whereby the card 489 inserted in the paper carriage 140 travels to the right in the slot 323 of the perforator, and takes up the position illustrated in Figs. 16 and 33. In the further movement to the right the stop pawl 474 moves away from the stop nose 504 and ratchets thereby over the stops F30, F22 and F31 (Fig. 11). Shortly before the termination of the carriage movement to the right the perforator carriage 319, 320 is prevented from moving further to the right by its stop angle 471 (Fig. 28) striking on the stop 477 fixed to the machine frame 302, whilst the paper carriage travels further for one or more carriage steps (a distance t (Figs. 28 and 31), up to its extreme right-hand position. The spring 349 is thereby tensioned, while the card 489 travels to the right freely for the amount t in the slot 323 of the perforator carriage 319, 320. The perforator carriage 319, 320 and the paper carriage 140 together with the card 489 thereby take up the position shown in Fig. 28, in which the contact C30 is in connection with the contact rail C31. In this position the card 489 is located with the extreme left-hand hole of the punchings 497 to 503 (Fig. 37) at the distance t (Figs. 32 and 37) to the right of the

punching pins 374. Now, if in this position the switches 508 and 534 (Fig. 40) are actuated, the switch 508 of course independently by the lever 3, the following circuit is closed: 532, 508, C31, C30, magnet coils 361 and 428 (Fig. 30). The magnet coils 361 and 428 thereby obtain current, whereby their cores 357 and 329 are attracted to the supporting members 353 and 425, and are swung round the bearing positions 365 and 430. They thereby act with their ends 370 (Fig. 20) and 431 (Fig. 21) on the punching pins 374 and 432 (Figs. 16, 20 and 21) and push these through the card 489 against the action of their springs 378 and 434, whereby a further punching 535 (Fig. 7) is thereby effected, which consists of one hole each on the two sides of the card at the edges thereof. This punching 535 (Figs. 32 and 37) which is provided at the same height as the value holes 407 to 503, correspond in regard to the distance of their two holes, to the distance of the sensing pins 448, 455 (Fig. 16) which as hereinafter described serve for the taking up of the card. By locking the perforator carriage before the paper carriage 140 arrives in its extreme right-hand position, according to the foregoing, the result is also obtained, that for the punching of the left-hand hole of the edge punching 535, the punching pin 374 with its associated parts already used for the value holes, can be applied.

After the circuit is re-opened by the actuation of the switches 508 and 534 (Fig. 40) and the perforating punches 374 (Fig. 20) and 432 (Fig. 21) with the parts associated with them are returned under the action of the strained springs 378 and 434 and withdrawn from the card 489, the card 489 is taken out of the machine. This is effected as in the introduction of the card 489, by corresponding rotation of the platen 152 and by way of the parts 482, 483, 486, 485, (Fig. 20) by the forwarding rollers 480 and 481. After the removal of the card 489 the same is laid aside for the purpose of effecting the next entry.

Sensing mechanism

The shaft 22 (Figs. 18 and 24), is extended to the left, and at the left-hand side is mounted in bearings in the supporting frame 536 of the machine frame 302. On the shaft 22 (Figs. 1, 18 and 24) is fixed a toothed wheel 537 by means of its boss 538, and a pin 539. The toothed wheel 537 is in engagement with a toothed wheel 540, which by means of its boss 541 and a pin 542, is fixed on a shaft 30. On the shaft 30 which constantly rotates, a cam 543 is loosely mounted by means of its boss 544, and is capable of acting on a lever 545. The lever 545 together with two further levers 546 and 547, held at the necessary distance in relation to each other by a distance ring 548 (Fig. 16) are pivotally mounted on a headed screw 550 screwed into a fixing angle 549 (Fig. 16). The fixing angle 549 is screwed by means of screws 551 to the inner side of the supporting frame 536. The lever 545 (Figs. 18 and 24) is capable of acting with its bent portion 552 on an arm 553 of a lever 554 which is pivotally mounted on a screw 556 screwed into a part 555. The part 555 is screwed by means of screws 557 (Fig. 24) to the left-hand space key lever 558, while its bent portion 559 is fixed to the space key 310, by means of a spring 562 which, on the one hand, is attached to the arm 553 of the lever 554, and on the other hand, to a spring connecting pin 561 fixed in the part 555, the lever 554 is constantly acted on in the clock-wise direction around its supporting screw 556, whereby its pin 564 riveted to its lower arm contacts with an arm 565 of the lever 546 already described, and thereby limits the swinging movement of the lever 554. The lever 546 is articulately jointed at its end 566 to a connecting rod 568 by means of a rivet 567, the connecting rod being combined with a core 569 of a magnet coil 570 to form a single unit. By means of a pin 572 riveted into its eye 571 the lever 546 is capable of acting on the lever 547. At its lower end 573 the lever 547 is articulately jointed by means of a rivet 574 to a connecting rod 575, which is combined with a core 576 of a magnet coil 577 to form a single unit. By means of a spring 580 which is connected, on the one hand, to a pin 579, fixed to the connecting rod 575, and, on the other hand, to a pin 579, the lever 547 is brought with its locking nose 581, into the locking position in relation to the nose 582 (Figs. 18 and 24) of a locking pawl 583, whereby the pawl is held in its rest position. The pawl 583 (Figs. 24 and 25) is pivotally mounted on a headed rivet 585, riveted into a disc-cam 584. The disc-cam 584 is fixed to the boss 544 of the cam 543 already described and along with this is loosely rotatable on the shaft 30. A spring 587 connected, on the one hand, to the locking pawl 583 and, on the other hand, to a pin 586 (Fig. 24) riveted into the disc-cam 584, is capable of holding the locking pawl 583 with its nose 582 in the locking position in relation to the nose 581 of the lever 547, or to bring the nose 588 of the disc-cam 584 into driving connection with a cam 589 (Figs. 24 and 25) fixed on the shaft 30. The disc-cam 584, the boss 544 and the cam 543 form, as is evident from Fig. 25, a unit which is held against axial displacement by the cam 589 and the boss 541 of the toothed wheel 540. When the disc-cam 584 is driven its curved projecting surface 590 acts on an arm 591 of a lever 592. The lever 592 (Figs. 16, 18 and 24) is pivotally mounted on a headed screw 593, screwed into a fixing angle 594 (Fig. 16) which on its part is fixed by means of screws 595 to the inner side of its supporting frame 536. The lever 592 is capable of acting with its arm 596 (Fig. 24) on a contact spring 597, and at the contacting position of both these parts, an insulator member 598 is fixed on the contact spring 597. In conjunction with insulator members 600 and 601 (Figs. 18 and 24) contact springs 597 and 599 are fixed by means of a screw 602 (Fig. 16) to a connecting bridge 603 of the supporting frame 536, whereby a contact F24 (Fig. 24) is formed. The magnet coils 570 and 577 are fixed to a part 605 (Figs. 16 and 18) which is screwed to the connecting bridge 603 of the supporting frame 536 by means of screws 606.

To the front side of the supporting frame 536 is screwed an angle bar 607 (Figs. 16 and 18) by means of screws 608, on which angle bar ten magnet coils 609 to 618 (Fig. 40) are fixed. The cores 619 to 628 of the coils 609 to 618 are articulately jointed by means of pins 629 to 638 (Fig. 18) to the calculating key levers 639 to 648 of the calculating keys. 198.

In the supporting frame 536 (Fig. 18) of the machine frame two angle members 649 are rigidly mounted by means of screws 650, one on the left-hand and one on the right-hand inner side (in Fig. 18 only the right-hand member is visible). On these two angle members a bar 651 formed of insulating material is rigidly mounted by means of screws, not illustrated. The bar 652 formed of insulating material is likewise fastened by means of screws, not illustrated, to angle pieces rigidly mounted 654, one on the left-hand and

one on the right side of the supporting frame 536 by means of screws 653. A bar 655 is fixed, on the one hand, to the bent-off part 656 of the right-hand side wall of the supporting frame 536 of the machine and, on the other hand, to the bent-off part, not illustrated, of the left-hand side wall of the supporting frame 536 of the machine. To this bar 655, further, an angle piece 662 is fixed by means of screws 647 for each magnet coil 658, 659, 660, 661, on which angle piece the magnet coils 658, 659, 660, 661 are rigidly mounted.

A number of contacts, for example, C1 to C27 (Fig. 40) some of which are opened and some closed, and are switched over by means of the magnet coils 658, 659, 660, 661 for a purpose to be hereinafter described, are distributed in four groups for this purpose. The first group consists of the contacts C1 to C7, and is switched over by the coil 658. The second group is formed by the contact C8 to C13, which are switched over by the coil 659. The contact C14 to C20 form the third group and are switched over by the coil 660. The fourth group consists of the contacts C21 to C27, which are switched over by the coil 661. In Figs. 22 and 23 the magnet 658 is illustrated with its contact group.

The part 663 (Figs. 22 and 23) of the U-shaped magnet core 664 projects through the magnet coil 658. On the free end of the part 663 of the magnet core 664 an armature part 665 is arranged in a corresponding slot, so as to be pivotable by means of a pin 666 which is fixed in the part 663. On both sides of the armature part 665, fixing angles 667 and 668 are riveted by means of rivets 669, to the bends 670 and 671 of which angles a trapezium-shaped bar 672 of insulating material is fixed by means of rivets 673 and 674. On both sides of the bar 651 formed of insulating material, spring plates 675 to 682 are fixed by means of rivets 683 to 686, and with their rests 687 to 694 form the contacts C2, C3, C4 and C7 (Fig. 40). On a further insulator bar 652 spring plates 695 to 700 are fixed at both sides by means of rivets 701 to 703, and with their rests 704 to 709 form the contacts C1, C5 and C6 (Fig. 40). A spring 711 which, on the one hand, is connected to a spring connecting pin 710, and, on the other hand, to a corresponding hole of the fixing angle 668, swings the armature part 665 and therewith the fixing angles 667 and 668 and the bar 672 constantly in the clock-wise direction round the bearing pin 666, the swinging movement being limited by striking of the armature part on a stop pin 712, and the rest position of the moved parts is thereby attained. In this position the bar 672 is clamped between the contact parts 704 to 709, so that the contacts C1, C5 and C6 are opened, whilst the contacts C2, C3, C4 and C7 are not acted upon by the bar 672 and for this reason are closed.

The magnet coils 659, 660 and 661 (Fig. 40) and the contracts C8 to C27 are arranged in the same manner as the magnet coil 658 and the contacts C1 to C7 respectively for which reason these are not illustrated separately, and in the description will not be described in greater detail.

A further contact C22 is formed by means of a contact plate 528 (Figs. 16 and 40) which is arranged on a ring 713 of insulating material pressed on to the shaft 22 and which co-acts with two contact springs 529 and 530 clamped between two insulator plates 714 and 715 and screwed together with them by means of screws 716 to the bridge 603 of the bearing frame 536.

The individual electrical control elements hereinbefore described are supplied from an electrical source of current 432 to 531 (Fig. 40) in the necessary manner and sequence for the working operations of the present mechanism over the network of wires represented diagrammatically in Fig. 40, after the circuits have been closed by way of switches 598 and 534.

Method of operation of the sensing mechanism

Before the card 489 is introduced anew for the registration of the next entry into the perforator carriage 319, 320, the perforator carriage must first be brought back into its initial position which forms the rest position. To this end the paper carriage, for example by operation of a corresponding tabulator key is first of all moved again to the left through at least a distance corresponding to the distance t (Figs. 28, 32 and 37) to the left. The striker angle 471 is thereby removed from the stop 477 (Fig. 28) so that the perforator carriage 319, 320 following the strained spring 439, takes up the initial position. This carriage movement to the left is more advantageously effected before the removal of the card after the completion of a booking operation, since this ensures that the perforator carriage 319, 320, on the introduction of the card 489 for a further booking operation, is located in the correct position. The card 489 is then introduced again for the next booking into the slot 323 of the perforator carriage 319, 320, whereby it falls with its lower edge between the forwarding rollers 480 and 481. Now the actuating lever 664 (Figs. 16 and 19) is swung out in the arrow direction 718, for the release of the paper feeding rollers 490 and 491, whereby the connecting member 466 is moved and with it the parts 463, 457, 444, 451, 445 and 443 by way of the pin 470. The sensing pins 455 and 448 are first displaced in the arrow direction 719 (Figs. 19 and 21) until they are pressed against the inserted card 89, whilst the lever 460 is swung out still further against the action of the spring 463, so that the latter is tensioned. By rotating the platen 152 by hand by the rotatable knob 487, the card 489 is gripped by the forwarding rollers 480 and 481 and drawn into the machine in the arrow direction 493 (Figs. 18 and 20), whereby its lower part is led by an additional paper guide plate, not illustrated, into the paper guide plate 494 proper (Figs. 18 and 20), and guided by this, is laid on the platen 152. The forwarding movement of the card 489 in the arrow direction 493 is limited as soon as the holes 535 (Figs. 32 and 37) of the card move into the range of the sensing pins 448 and 455, so that the latter are moved in the arrow direction 719 through the holes 535 of the card 489 into the extensions in the perforator carriage part 319 of the corresponding holes in the perforating carriage part 320, by way of the parts 445, 451, 444 and 457 following the tensioned spring 463. In this position the card 489 along with the forwarding rollers 480 and 481 are stopped, the friction drive provided preventing the card holes being torn out when the platen 152 is moved still further after the card 489 has already been stopped by the sensing pins 448 and 455. After the card 489 is stopped by the pins 448 and 455 in the typing position, the paper feeding means are again brought into operation by actuation of the lever 464 in the opposite direction of the arrow 718 (Fig. 19). The sensing pins 448 and 455 are moved back into their initial position (Fig. 19) by way of the parts 466, 470, 460, 463, 457,

444, 455 and 451, whereby they are disengaged again from the edge punching 535 of the card 489.

Since the sensing pins 448 and 455 lie at the same height as the testing pins 389 to 392 and the holes 535 co-acting with the sensing pins, lie at the height of the holes 497 to 503, so the holes 487 to 503 lie at the level of the testing pins 389 to 392. Since however, on the other hand, the sensing pins 448 and 455 and the testing pins 389 to 392 lie in a position higher by the distance of one line than the punching pins 374 to 377, so the card 489 is to be pushed less deeply in the arrow direction 493 (Fig. 18) by the distance 721 of a line (Fig. 32), so that now the line indicated with 72 (Fig. 32) lies at the typing height.

To commence with, the account number, date, and text of the entry is again typed by means of the typing keys 209. The paper carriage 140 is then brought with the column I of the card 489 into the typing position by operation of the corresponding tabulator key 185. The value 750,00 is first typed by means of the calculating keys 198 in the column I of the card 489 as a debit value, and simultaneously registered in the corresponding totalizer T1. This value is transmitted into the cross footer plate 50 of the totalizer T1, in this case, therefore, subtractively. Now, in the column IV the old balance "30750,00" is automatically registered by sensing the holes 497 to 503; this is effected as follows:

By further tabulating operations the paper carriage is moved into the highest denomination of the column IV. The paper carriage 140 now takes up the position according to Fig. 35, in which the contact C29 has come into contact with the fixed contact C31. In this position the pawl 474 of the perforator carriage 319 to 320 is brought into engagement with the projection 722 of the stop 476, whereby the perforator carriage 319, 320 is held stationary, so that the paper carriage 140 together with the totalizers T1 to T6 and the account sheet 489 alone is moved further to the left. The value "30750,00" as described in the following is now sensed denomination by denomination automatically, and therefore registered additively in the corresponding totalizer T4 and in the cross footer CT, and typed in the column IV as old balance. The sensing of the value "30750,00" is effected similarly to the punching by means of four testing pins 389 to 392, which come into operation for this purpose singly or by two's according to the key in Fig. 39. In order that the magnet coils 609 to 618 operating the calculating keys 198 for the numbers "0" to "9" can all be actuated and in the correct sequence by the four testing pins 389 to 392, the latter influence first four magnet coils associated with them likewise in the determined assembly singly or by twos, which on their part act again in like manner on the contacts C1 to C27, subdivided into four groups. By the switching over operation effected thereby which opens one part of the contacts, while it closes another part the result is attained that in the sensing of the numbers "0" to "9" at the time being, only a single coil of the magnet coils 609 to 618 corresponding to the value hole is actuated. After, therefore, the paper carriage 140 is located with the column IV of the card 489 in the typing position, the card 489 lies with the value punching 497 (Fig. 48) corresponding to the first number "3" of the value "30750,00" (Fig. 38) opposite to the testing pin 391. Accordingly the latter moves through the hole and consequently contacts with the conducting bar 388 (Fig. 20). Now if the switch 508 is closed the sensing operation sets in automatically. The current now passes from 532 by way of 508, C31, C29, 388, 391, 405, magnet coils 660 and 577 to 531 (Fig. 40). The magnet coils 660 and 577 thereby obtain current. The magnet coil 660 thereby acts in the manner hereinafter described for the magnet coil 658 the switching over of the contact group C14 to C20 (Fig. 40) associated with it. The contacts C14, C15, C17 and C18, which are closed in the rest position, are thereby opened, and the opened contacts C16, C19 and C20 are closed. The circuit now takes the following path: 532, 508, C29, 723, C21, C16, closed through the magnet coil 660, C10, C3, magnet coil 611, to the contact 724. By the excitation of the magnet coil 577 in the sensing operation, the rod 575 (Fig. 24) is acted upon in arrow direction 725 and against the action of the spring 580, whereby the lever 547 is swung out in an anti-clockwise direction around its supporting position, and its nose 581 is withdrawn from the nose 582 of the coupling pawl 583. The coupling pawl 583 following the tensioned spring 587 is acted upon in the anti-clockwise direction around its supporting rivet 585 (Figs. 24 and 25) fixed in the disc-cam 584, and is thereby brought into driving connection with the cam 589 of the constantly rotating shaft 30. The disc-cam 584 now participates in the rotational movement of the shaft 30 in the anti-clockwise direction and acts after a part, for example, a third of the revolution on the lever 592. The latter is thereby swung in the anti-clockwise direction around its support, whereby it acts on the spring 597 and thereby closes the contact 724. The running time which hereby occurs enables the starting magnet 660 to come completely to rest, so that no false contacts arise. The contact 724 now closes the circuit finally, so that the magnet coil 611 obtains current by way of 531. The core 621 of the coil 611 is thereby attracted and consequently the calculating key lever 641 corresponding to the calculating key 198 of the "3" is drawn down.

The number "3" of the value "30750,00", is thereby registered in the corresponding totalizer T4, and is transmitted additively into the cross footer CT corresponding to the setting of its presetting plate 59, while it is simultaneously typed in the column IV of the card 489.

In the carriage movement to the left for one step which thereby results and in which according to the foregoing the perforator carriage does not participate, the card 489 in the slot 323 of the perforator carriage 319, 320 is moved freely to the left. The connection of the contact pin 391 with the bus bar 380 is thereby interrupted by the interposition of the card 489, and the magnet coils 660 and 577 are again without current. Accordingly, the contacts C14 to C20 are brought again into their initial position, whereby the contact C16 is opened again, and the magnet coil 611 is thereby again without current. The calculating key lever 641 returns into its rest position following its spring, not illustrated, whereby the calculating and typewriting operations are completed. The magnet coil 577 (Figs. 24 and 40) is thereby also without current, whereby the rod 575 under the action of the spring 580 is moved back in the opposite direction to the arrow 725 (Fig. 24) into the initial position. The lever 547 thereby moves so that its nose 581 is again within the range of the nose 582 of the coupling pawl 583. At the end of the introduced rotation of the shaft 30, the coupling 583, 589 is thereby released, so that

the lever 592 is no longer operative. All the foregoing mechanisms which were actuated have therefore returned into the rest position again.

After the termination of the carriage step which is effected at this point, the card 489 is positioned with the value punching 489 (Fig. 38) corresponding to the next number "0", of the number "30750,00", opposite to the testing pins 389, 390, so that the latter move into contact with the bus bar 389 through the punching. The following circuit is thereby closed: 532 (Fig. 40) 508, C31, C29, 388, 390, 404 and 388, 389, 403, magnet coils 659 and 658 and 577, 531. The magnet coils 658, 659 and 577 effect in the manner hereinafter described the switching-over of the contact groups C1 to C7 and C8 to C13. By means of the current which flows through the coil 658 (Figs. 22 and 23) the part 664 becomes magnetic and attracts the armature part 665 so that the latter with the parts 667, 668 and 672 are swung against the action of the spring 711, round the supporting pin 666 in the anti-clockwise direction. The trapezium-shaped insulator bar 672 thereby frees the contact members 704 to 709, so that the contacts C, C5 and C6 are closed by the action of the springs 695 to 700. The bar 672 is thereby moved between the contact pieces 687 to 694 against the action of the springs 675 to 682 and thereby opens the contacts C2, C3, C4 and C7. In the manner just described, the contacts C8 to C13 are also switched-over by means of the magnet coil 659 (Fig. 40) whereby the contacts C8, C10, C11 and C13 are opened, and the contacts C9 and C12 closed. Also, the switching-over of the contacts C14 to C20 hereinbefore described, by means of the magnet coil 660, and the switching-over of the contacts 621 to 627 by means of the magnet coil 661 results exactly in the manner hereinbefore described for the coil 658 and the contacts C1 to C7, for which reason it has only been described for this group and illustrated. The circuit takes after the following path, switching-over the contacts C1 to C13 by the magnet coils 658 and 659: 532, (Fig. 40) 508, C31, C29, 723, C21, C14, C9, closed by the magnet coil C6, closed by the magnet coil 658, magnet coil 618 up to contact F24. Since, as above mentioned, the magnet coil 577 is excited again in this case, the contact 724 has again been closed in the manner already described. With this the circuit is again definitely closed, and the magnet coil 618 obtains current by way of 531. The core 628 of the magnet coil 618 is thereby attracted, and draws down the calculating key lever 648 corresponding to the calculating key 198 of the number "0". Since in the actuation of the calculating key for the number "0" no calculating operation results, the number "0" is only printed in the column IV of the card 489. The paper carriage 140 with the card 489 thereby obtains a further movement of one step to the elft. Since the card 489 is thereby moved again between the testing pins 389 and 390, and the bus bar 389, these contacts are opened and the magnet coils 656 and 659 as well as 577 are without current. Accordingly, the armature part 665 of the magnet coil 658 (Figs. 22 and 23) and the parts 667, 668, and 672 are brought back, under the action of the spring 711, into their initial position which is determined by the parts 665, 667 and 668 striking on the stop pin 712. The contacts C1 to C7 have thereby taken up again their initial position (Figs. 22 and 23) while being influenced by the springs 675 (Fig. 23) to 682 and against the action of the springs 695 to 700. In the same manner the contacts C8 to C13 have also been returned to their rest position. Since the contacts C9 and C6 were thereby opened again, the magnet coil 618 has been deenergized, so that the calculating key lever 648 returns into its initial position under the action of its spring. Since the magnet coil 577 also is again without current, the contact 724 remains also open in the manner already described. All the operative mechanisms in the sensing operation have therefore again returned into the initial position.

Now, after the next effected carriage step has ended the card 489 stands with the punching 499 (Fig. 38) corresponding to the next number "7" of the value "30750,00" opposite to the testing pins 389 and 392, so that these are connected through the punching with the bus bar 388. The circuit 530 (Fig. 40) 508, C31, C29, 380, 392, 406 and 388, 389, 403, magnet coils 661, and 658 and 577, 531, is thereby formed, whereby the magnet coils 658, 661, as well as 577 are excited. The magnet coil 658 effects in the manner hereinbefore described the changing-over of the contact group C1 to C7, whereby the contacts C5 and C6 are closed and the contacts C2, C3, C4 and C7 are opened, while the magnet coil 661 changes-over the contact group C21 to C27, whereby the contacts C23, C24, C25 and C27 are closed, and the contacts, C21, C22 and C26 are opened. The circuit now takes the following path: 532 (Fig. 40), 508, C31, C29, 723, C1 (closed by the magnet coil 658) C8, C15, C25 (closed by the magnet coil 661) magnet coil 615, up to the contact 724. Now, since the contact 724 was also closed in the manner above described by the disc-cam 584 controlled by the magnet coil 577 the circuit is closed, so that the magnet coil 615 obtains current by way of 531. The core 625 (Fig. 40) of the magnet coil 615 is thereby attracted and with the latter the key lever 645 corresponding to the calculating key "7" is drawn down. In the calculating process which thereby follows, the number "7" of the value "30750,00" is registered in the totalizer T4, and, in consequence of the setting of the pre-setting plate 50 at addition, is also transmitted additively to the cross footer CT. After the simultaneous printing of the number "7" in the column IV of the card 489 is effected, a further carriage step to the left takes place. The connection of the parts 388, 389 and 388 and 392 are thereby released, whereby the mechanisms actuated in the sensing operation previously carried out come to the rest again in the manner already described.

On the completion of the carriage step which has been released, the paper carriage stands with the punching 500 (Fig. 38) of the card 489, corresponding to the next number "5" of the value "30750,00" opposite to the testing pins 389 and 391. The testing pins 389 and 391 thereby obtain connection through the punching 500, with the bus bar 388, and thereby close the following circuit: 532, (Fig. 40), 508, C31, C29, 388, 391, 405, and 388, 389, 403, magnet coils 660 and 658, and 577, 531, whereby the coils 658 and 660 as well as 577 obtain current. The magnet coil 658 thereby switches over the contact group C1 to C7 and closes the contacts C1, C5 and C6 and opens the contacts C2, C3, C4 and C7, whilst the magnet coil 660 switches over the contact group C14 to C20, whereby the contacts C16, C19 and C20 are closed. The circuit now takes the following path: 532, (Fig. 40) 508, C31, C29, 723, C21, C12 (closed by magnet coil 660) C10, C5,

(closed by magnet coil 558), magnet coil 613 up to contact 724. After the contact 724 is closed by the disc-cam 584 controlled by the magnet coil 577, the circuit is closed and the magnet coil 613 obtains current from 531. The core 623 of the magnet coil 613 is thereby attracted and therewith the calculating key lever 643 corresponding to the calculating key of the number "5" is drawn down. By the calculating operation thereby released the number "5" of the value "30750,00" is registered in known manner in the totalizer T4, and transmitted to the cross footer CT, whilst it is simultaneously typed in the column IV of the card 489. After the typing of the number "5" has taken place, the paper carriage 140 obtains a further movement of one step to the left, whilst the connection of the contact parts 388, 391 and 388, 389, is released, and the mechanism actuated in the previously effected sensing operation return into their initial positions in the manner already described.

After the carriage step has been completed, the carriage is located with the punching 501 (Fig. 38) of the card 489 corresponding to the next number "0" of the value "30750,00" opposite to the testing pins 389 and 390. The sensing operation hereby effected is exactly the same as was released with the first number "0" of the value "30750,00" for which reason it will not be further described here. On completion of the carriage step which was effected at this point, the paper carriage 140 with the card 489 stands with the comma place of the value "30750,00" in the calculating position. Since the card 489 does not show any value punching in this position and consequently no contact-giving connection of the testing pins 389 to 392 is produced, no sensing and calculating operations can result in this case. In order to bring the paper carriage 140 into the position for the next sensing operation in which the next lower denomination of the value "30750,00" is in the calculating position, the space key is actuated as follows:

Through the circuit 532 (Fig. 40) 508, C31, C29, 723, C21, C14, C13, C7, 570, 531 (Fig. 40) closed in this position of the paper carriage 140, the magnet coil 570 (Fig. 24) obtains current, so that its coil core 569 is attracted and the rod 568 (Fig. 24) is moved in the arrow direction 725. The articulately jointed lever 546 is thereby swung in an anti-clockwise direction round its support, whereby its arm 565 acts on the pin 564 and swings the lever 556 in the anti-clockwise direction round its supporting screw 556 and against the action of the spring 562. The lever 554 in this position lies under the bend 552 (Fig. 24) of the lever 545. Further, the pin 572 of the lever 546 acts in this swinging movement on the lever 547, and swings the latter likewise in the anti-clockwise direction round its support, whereby the articulately jointed rod 575 is moved along with it in the arrow direction 725, against the action of the spring 580, without, however, influencing thereby any further part. In the swinging of the lever 547, its nose 581 is withdrawn from the nose 582 of the coupling pawl 583, so that the latter following the tensioned spring 587, swings round its support and moves into driving connection with the cam 589 of the shaft 30. The disc-cam 584 participates in the succeeding revolution of the shaft 30 by way of the coupling 583, 589, whereby it swings out the lever 592 on a part, for example, a third of this revolution, and closes the contact 724. This influence, however, no further mechanisms as no further circuit is thereby closed. On the rotation of the disc-cam 584 however, the disc-cam 543, which is rigidly connected with it, is rotated along with it. The cam 543 in the first half of its revolution acts on the lever 545 and swings it in a clockwise direction round its supporting screw 542. The lever 545 thereby presses by means of its bend 552 on the lever 554, which as above described, was brought into the working position in relation to the bend 552 of the lever 545. The space key 310 is thereby drawn down by way of the part 555 and the space key lever 558, so that the paper carriage 140 is released for a further movement of one step towards the left. During the drawing down of the space key 310, the pin 564 slides along on the arm 565 of the lever 546, and thereby holds the lever 554 in the operative position in relation to the lever 545. The skipping of the comma space can also take place in the manner described under the heading "comma skipping device."

After the termination of the carriage step which occurred in moving from the comma position into the next lower denomination, the carriage 140 stands with the punching 502 (Fig. 38) of the card 489 corresponding to the following number "0" of the value "30750" opposite to the testing pins 389 and 390, whereby the same sensing operation is released as in the previous number "0" of the value "30750,00" for which reason they shall not be gone into in detail at this point. Since the contact group C1 to C7 and C8 to C13 is switched over, that is the contact C13 and C17 are opened the circuit 532 (Fig. 40) 508, C31, C29, 723, C21, C14, C13, C7, 570, 531 is first interrupted, and the magnet coil 570 is de-energized, so that the parts 554, 546, 568, can return into the initial position under the action of the spring 562, in which position the lever 554 is located out of the working position in relation to the lever 545. On the contrary, the parts 457, 575 cannot follow this spring 580, i. e., they cannot therefore return into the initial position; on the contrary, they are held in the swung-out position, since through further sensing operation effected, as hereinbefore described, the magnet coil 577 was excited. The coupling of the disc-cams 584 and 543 and of driving shaft 30 therefore, is not released, whereby the disc-cams 584 and 543 are rotated further. The disc-cam 543 thereby influences the lever 545 further, which, however, can no longer operate the space key 310, as the lever 554, according to the foregoing, is out of the working position in relation to it. By the rotation of the disc-cam 584 the contact 724 is operated for the purpose already described in the foregoing sensing operations.

Now after the number "0" has been printed, and the carriage has moved to the left for one step further, it is located with the punching 503, corresponding to the next number "0" of the value "30750,00" opposite to the testing pins 389 and 390, whereby the same sensing operation is effected again as in the sensing of the previous sensed numbers "0" of the value of "30750,00." After the last number "0" of the value "30750,00" has been typed in the corresponding column IV of the card 489 and the corresponding carriage movement to the left has taken place, the whole sensing process is ended according to which the whole number "30750,00" is registered in the corresponding totalizer T4, transmitted into the cross footer CT and simultaneously typed in the column IV of the card 489.

After the carriage step which took place on the

last sensing operation, the switch **508**, **509** is opened by hand, and the locking pawl **474** is brought by hand out of the working position in relation to the nose **722** of the stop **476**, whereby the perforator carriage following the strained spring **350** returns into its initial position. By operating the corresponding tabulator key **185** the paper carriage **140** is now brought with the column IV into the typing position in the manner described under the title "Tabulating device."

Now by operation of the TC key, the value "30000,00" calculated in the cross footer is cleared out of this again automatically denomination by denomination in the manner described under the title "Total-taking," and transmitted to the corresponding totalizer T6, whereby it is printed simultaneously in the corresponding column VI of the card **489**. The value "30000,00" is thereby likewise automatically punched denomination by denomination on the card **489** in the manner already described for the value "30750,00," so that the punching **728** (Fig. 32) issues at the distance of a line **721** under the value punching "30750,00." Then after the completion of the total-taking the carriage is brought into its extreme right-hand position, in which the edge punching **729** (Fig. 32) lying at the same height as the value punching **728**, is effected on the card **489** in the manner previously described for the edge perforation **535**. The card **489** is taken out of the mechanism in the manner already described and laid aside.

Any further entries on the card **489** are effected in the same manner as the two entries previously described.

Now, if a value, for example "200,00," whose highest denomination does not reach to the highest in the present case, i. e., to the ten thousands denomination forming the capacity, the paper carriage **140**, which begins the sensing and typing of a value in the highest place of the value capacity, must first skip from this to the highest denomination corresponding to the value to be sensed. This is obtained as follows by operation of the space key **310**, and this must be twice actuated in the present case until the card **489** with the value punching corresponding to the number "2" of the value "200,00" stands opposite to the testing pin **390**, after which the value punching proper can commence.

On the arrival of the carriage with the column IV of the card **489** as above described, the switch **508**, **509**, (Fig. 40) is operated, whereby the following circuit is closed: **532** (Fig. 40) **508**, **509**, **C31**, **C29**, **723**, **C21**, **C14**, **C13**, **C7**, **570**, **531**. Since the magnet coil **570** thereby obtains curent, the space key **310** is operated in the manner hereinbefore described, and the operation is repeated until the paper carriage **140** through the carriage steps which thereby result stands with the punching, not illustrated, of the card **489** corresponding to the number "2" of the value "2000,00" to be sensed opposite to the testing pin **390**, corresponding to the number "2." In the sensing operation which is thereby effected in the manner already described for other number values, the contact **C13** is opened by switching-over of the contact group **C8** to **C13**, so that the above-mentioned circuit is interrupted and the magnet coil **570** is de-energised. The lever **554** is thereby brought out of the working position again in relation to the lever **545** by means of the spring **362**, in the manner already described, so that in the further operation of the lever **545** the space-key **310** is no longer acted upon.

In the punched and sensed values, as above-described, which are entered in the columns IV and VI (Fig. 32) of the card **489**, the matters dealt with relate to credit items, that is, positive values. In the punching and sensing of debit items, that is, negative values, which are entered in the columns III and V, the locking pawl **474** for the purpose of locking the perforator carriage **319**, **320** during the punching and sensing co-acts with the stop noses **730** and **731** (Figs. 34 and 36) of the stop **476**. For the remainder, the punching and sensing operation is effected in the same manner as in punching and sensing of credit entries. By means of the present mechanism, therefore, a value typed denomination by denomination on a booking card by total-taking is simultaneously and likewise automatically punched on the card denomination by denomination in order that on the succeeding registration of an entry on the card **489**, the value punchings which thereby issue are likewise automatically sensed denomination by denomination and thereby typed as an old balance at a corresponding place on the card **489**. For this purpose the card **489** as mentioned, must be set on the first entry line **496**. For locating the card **489** on the correct line for successive entries, edge punchings are made in the card **489** at the end of each value punching effected and are located at the same height as them.

Although the locating of the card **489** is effected by means of edge perforations **535**, **729** (Fig. 32) on both sides of the card, the same can also be obtained with the edge punchings on one side by accurate guiding of the card.

Although the present arrangement is described in conjunction with a type writing-calculating machine or the like with automatic total taking mechanism, obviously it can also be applied in type writing-calculating, machines or the like in which the total taking is effected by hand by actuating the corresponding calculating keys.

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23 Sheets-Sheet 1

Fig. 1

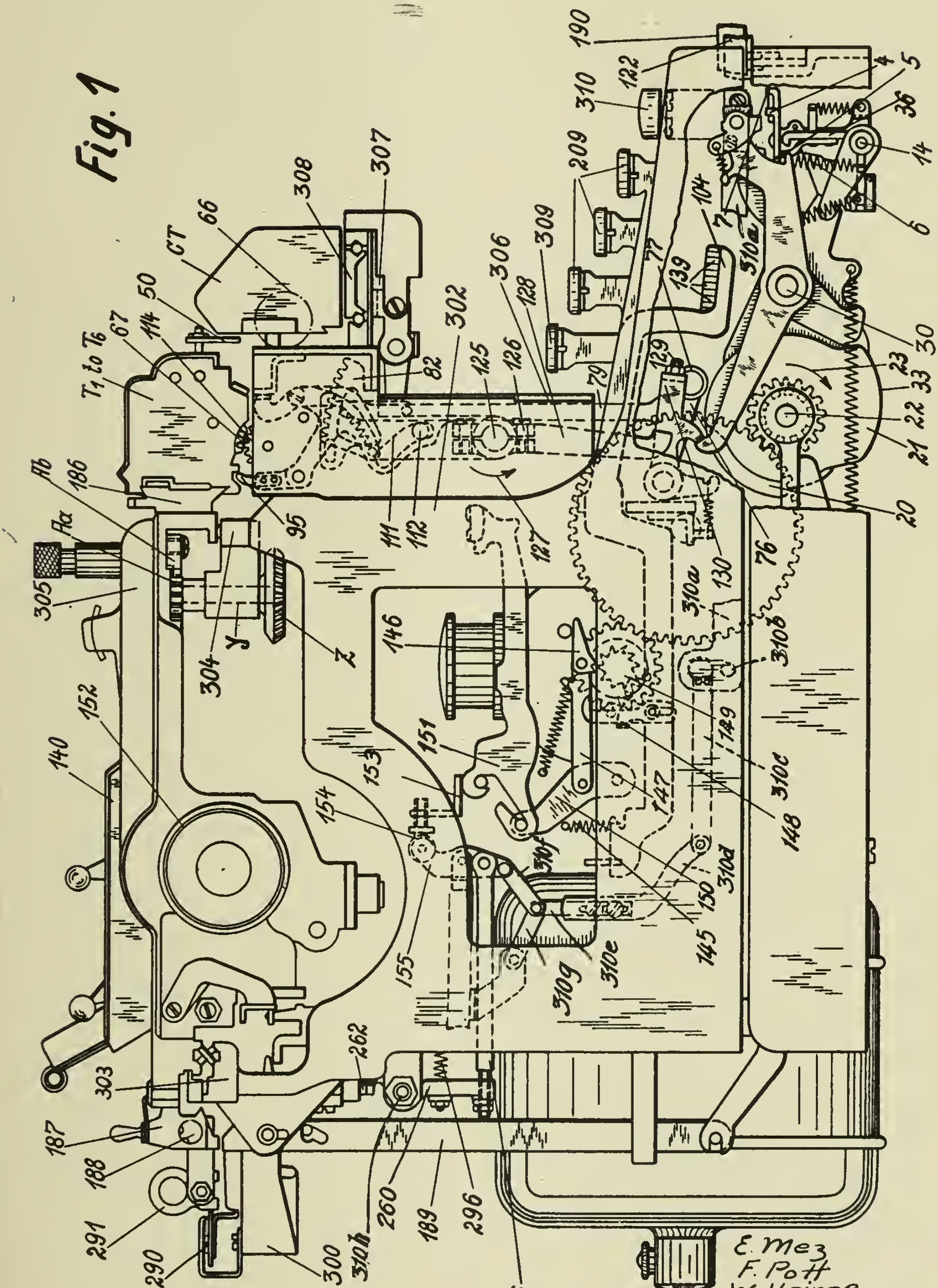

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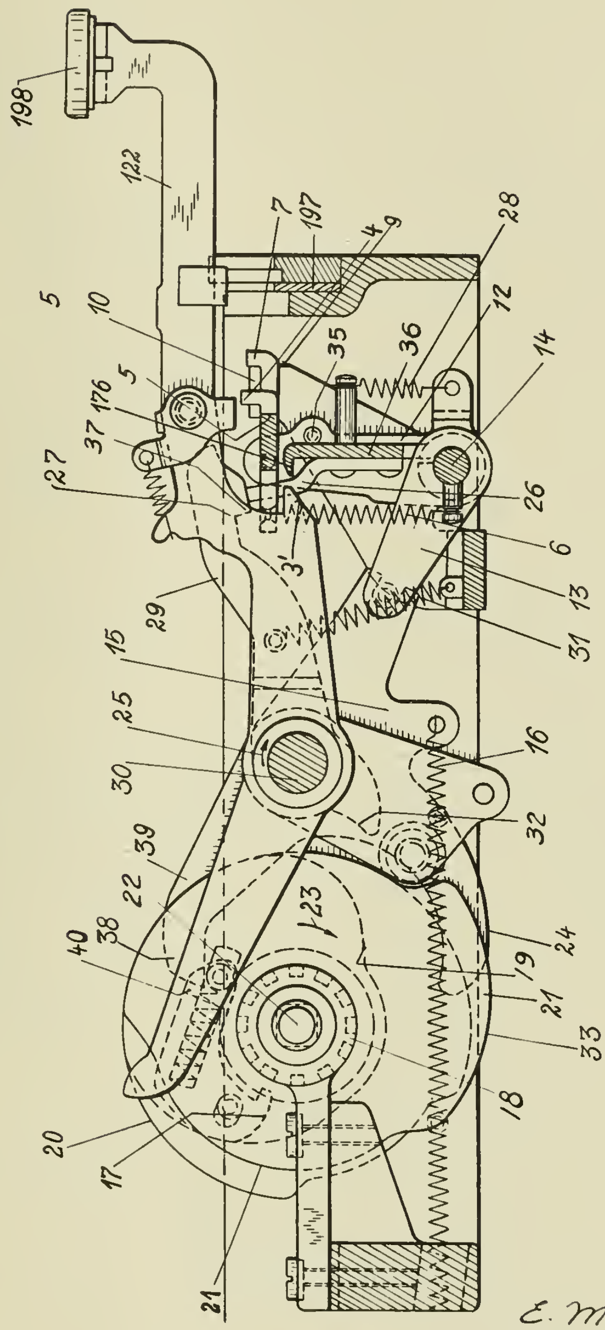
Fig. 2



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23 Sheets-Sheet 3

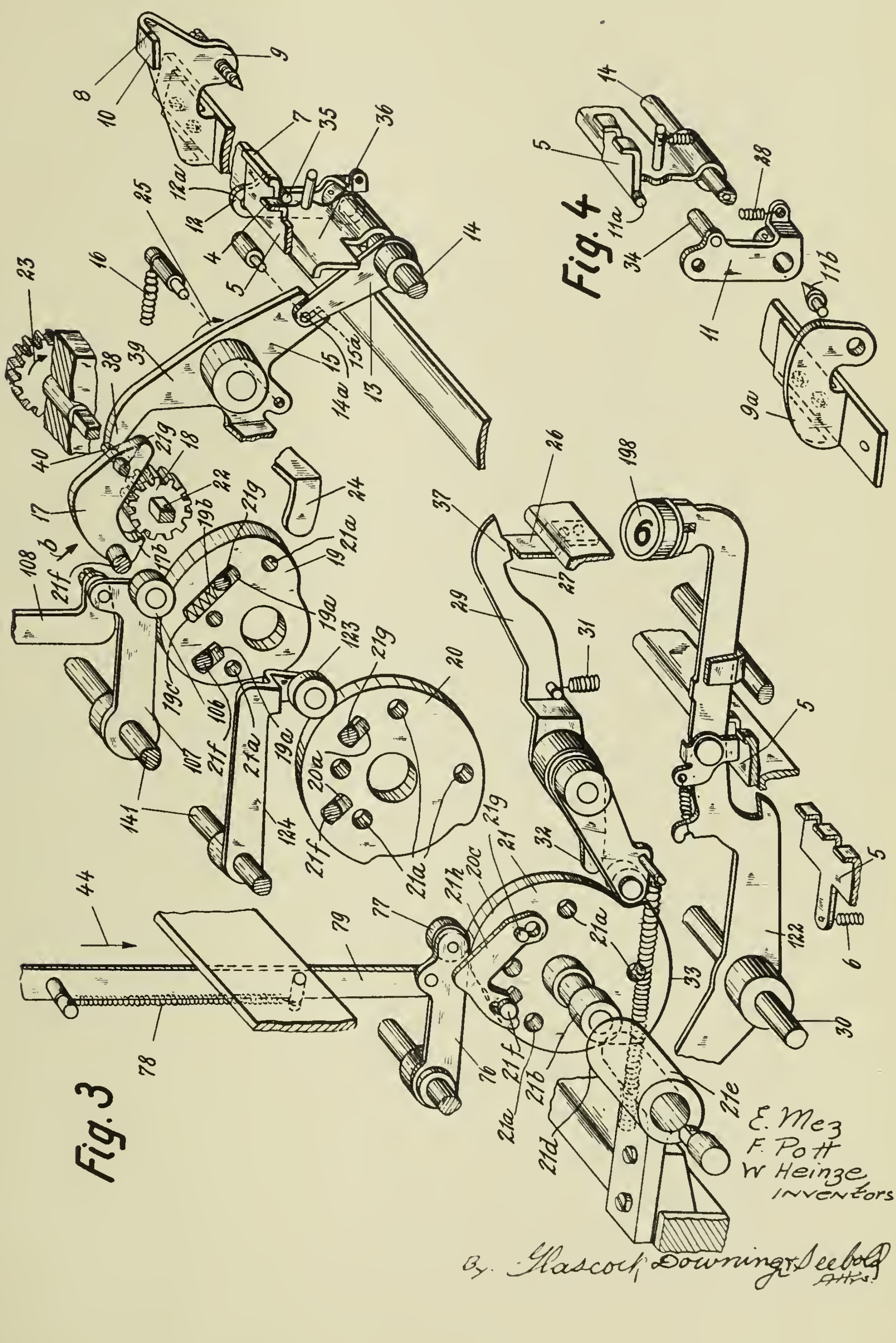

Fig. 3

Fig. 4

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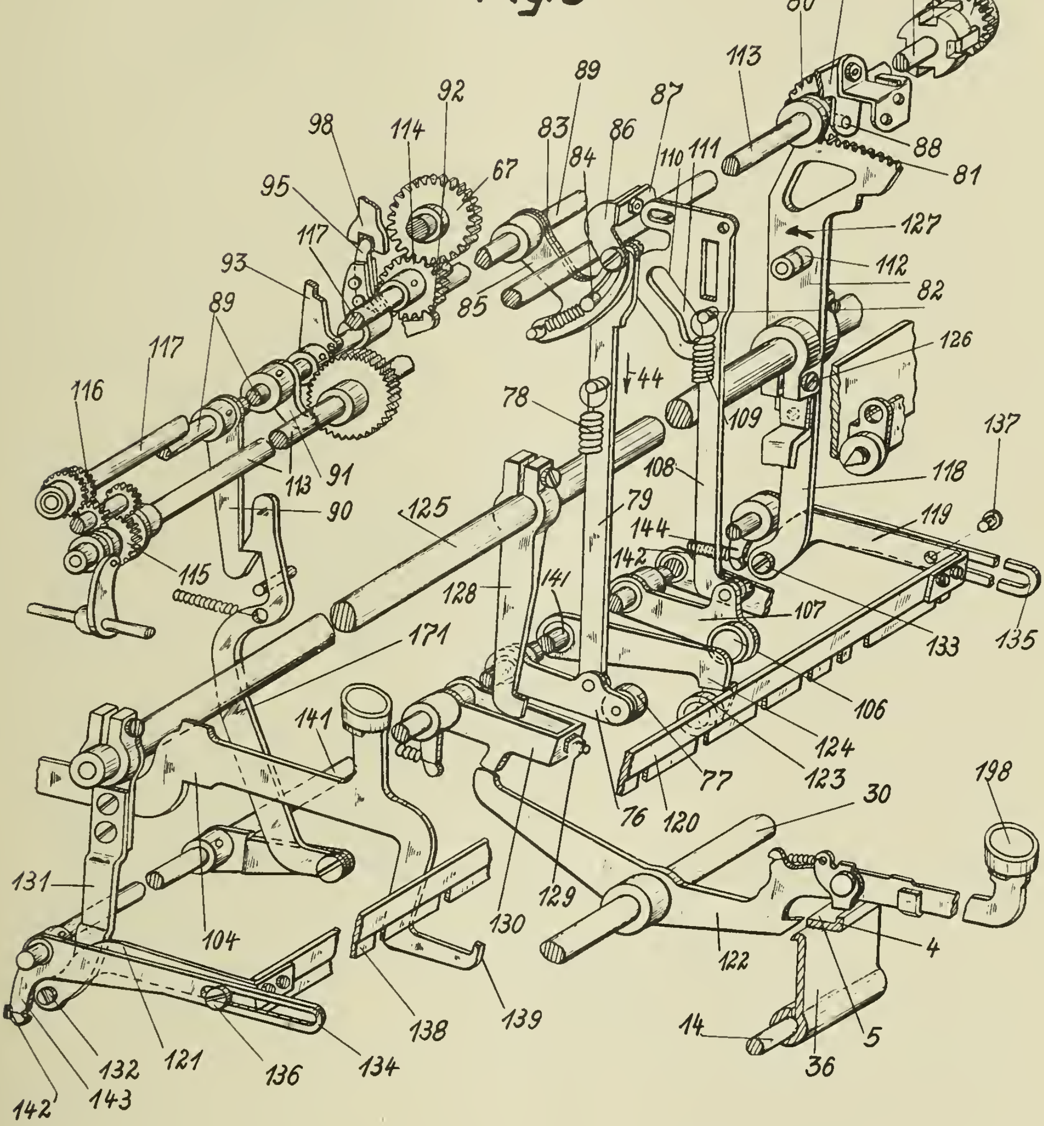
Fig. 5



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23 Sheets-Sheet 5

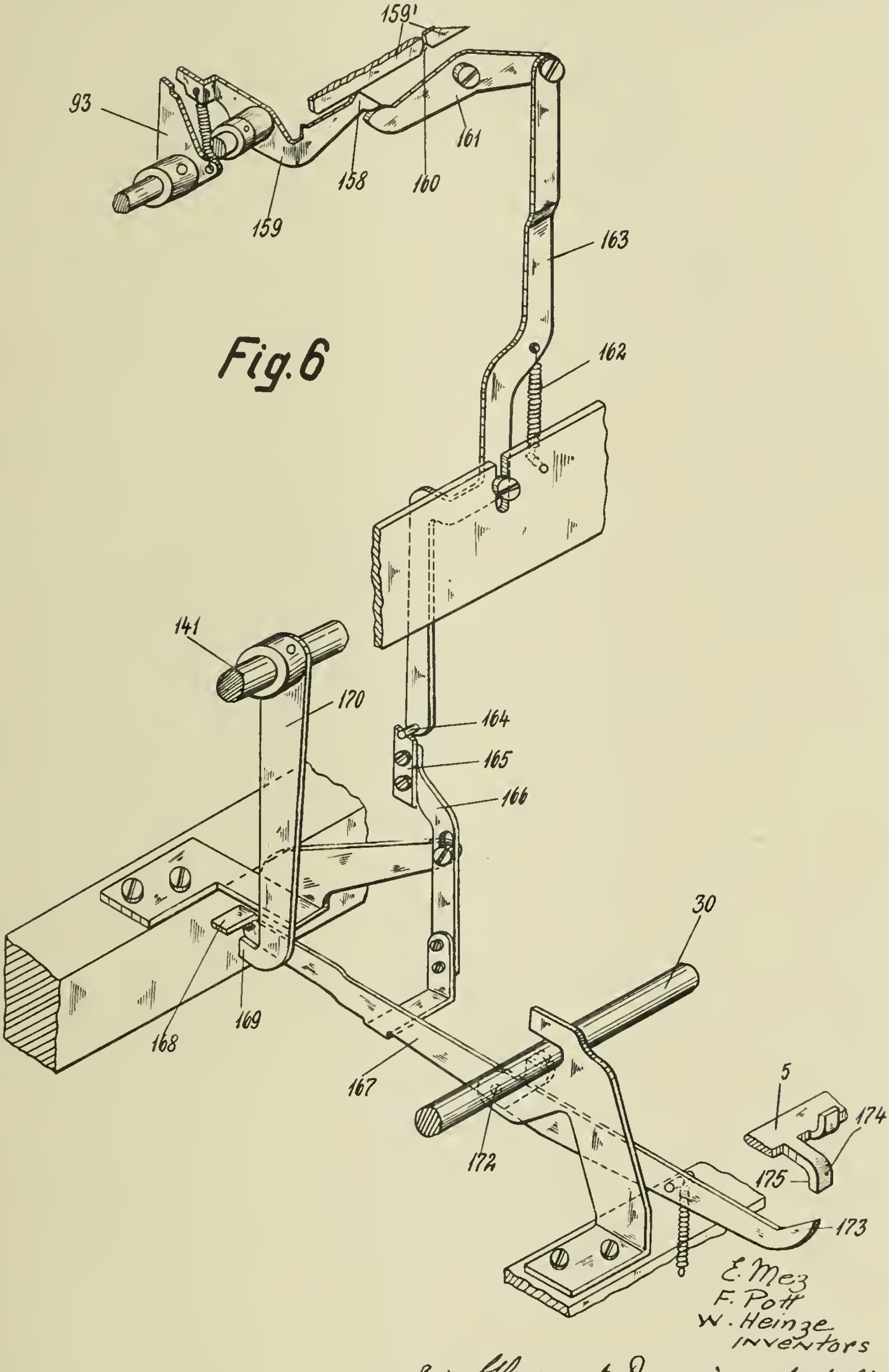

Fig. 6

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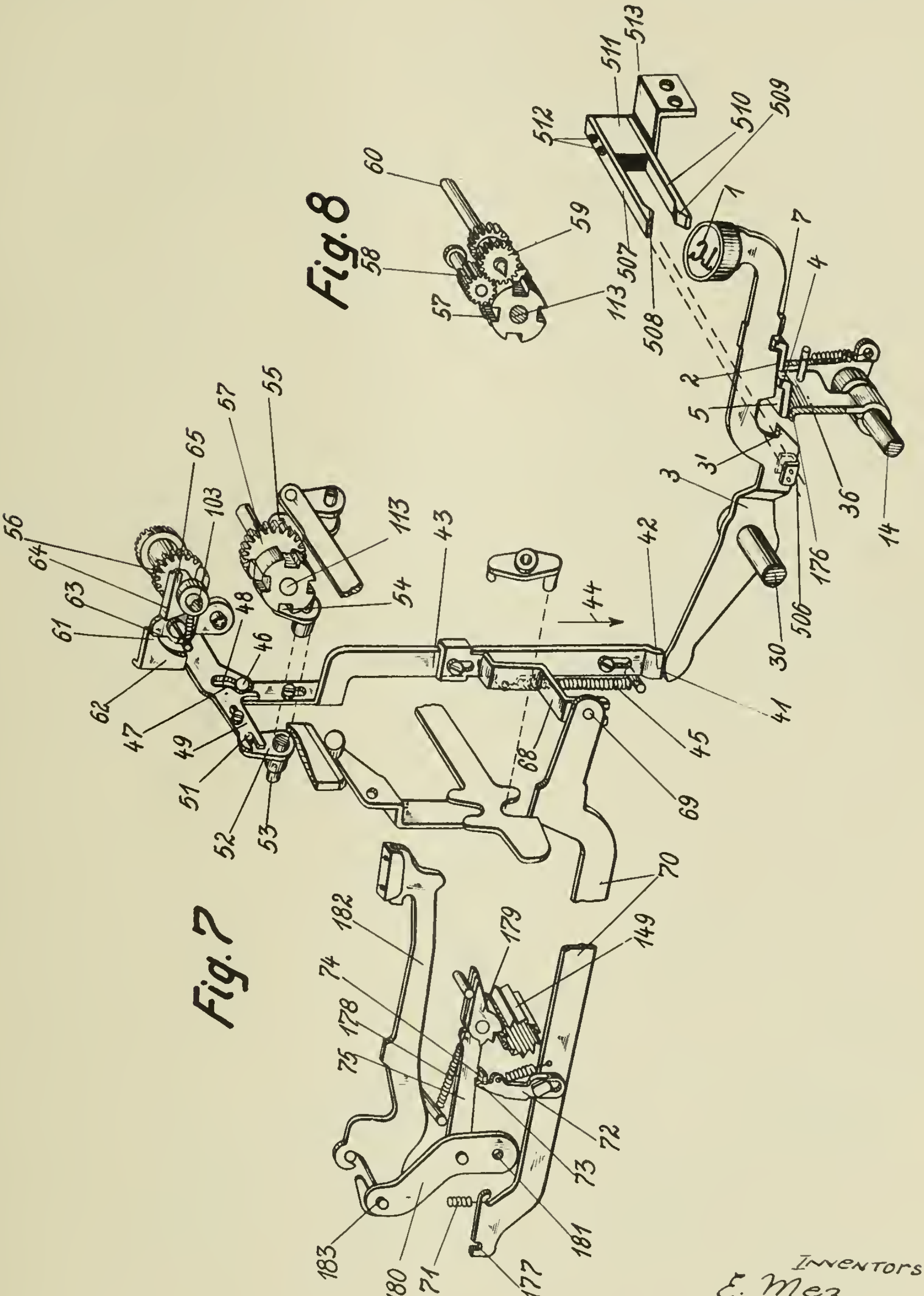

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Fig. 17

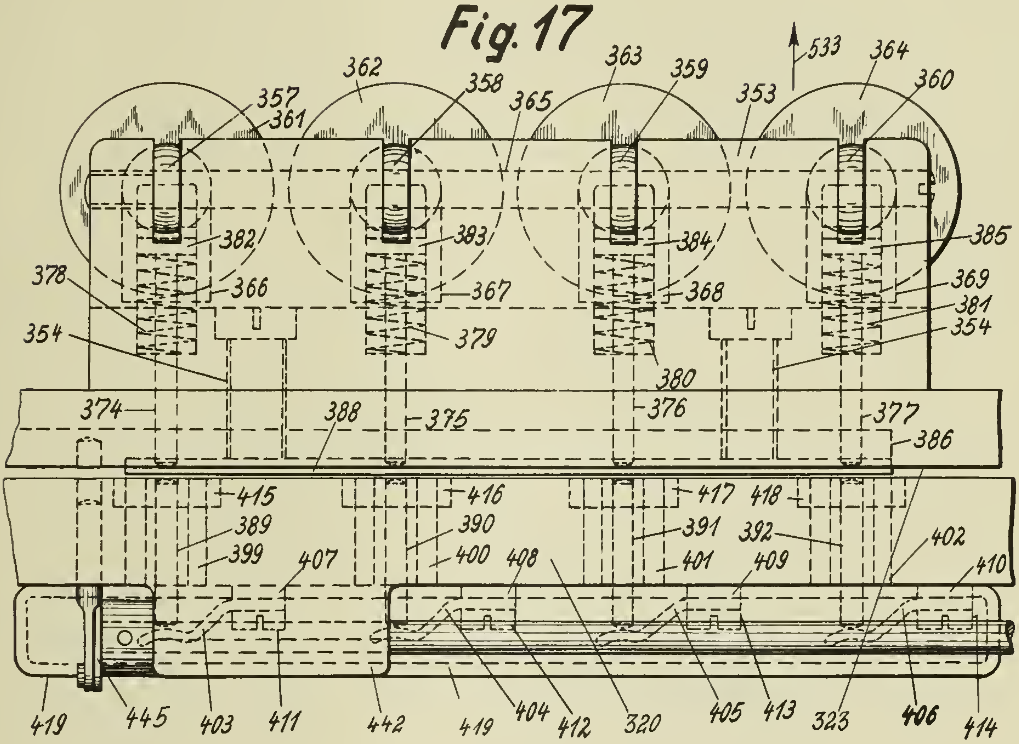

Fig. 9

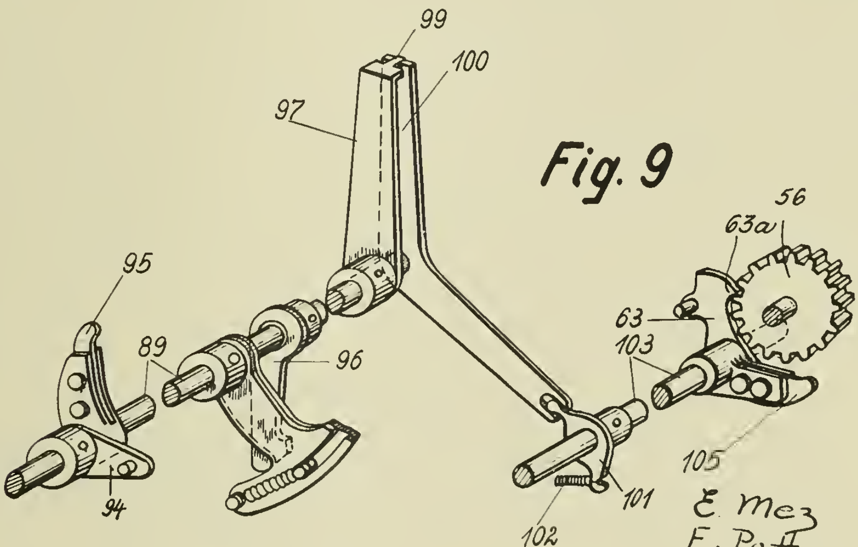

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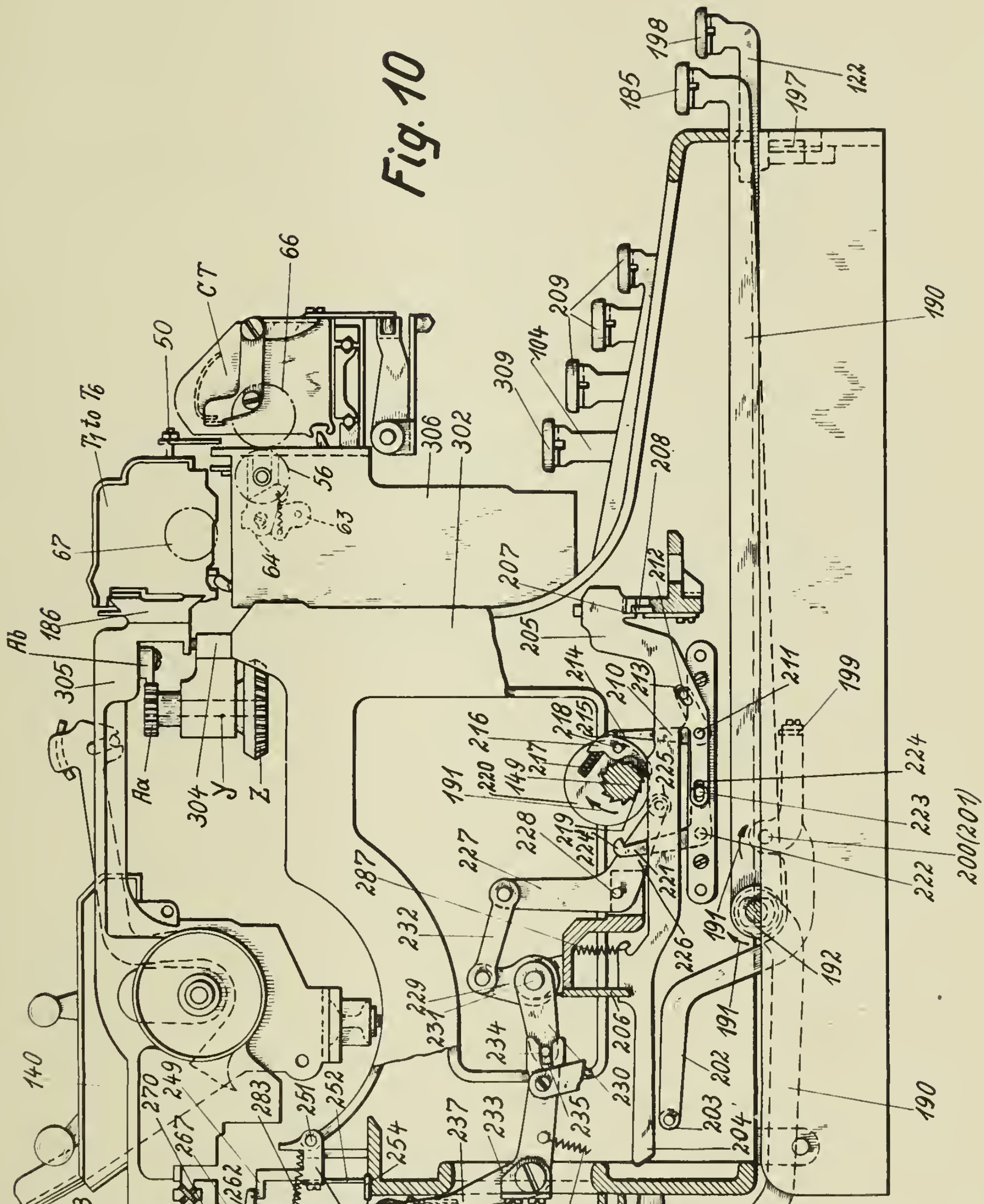
Fig. 10



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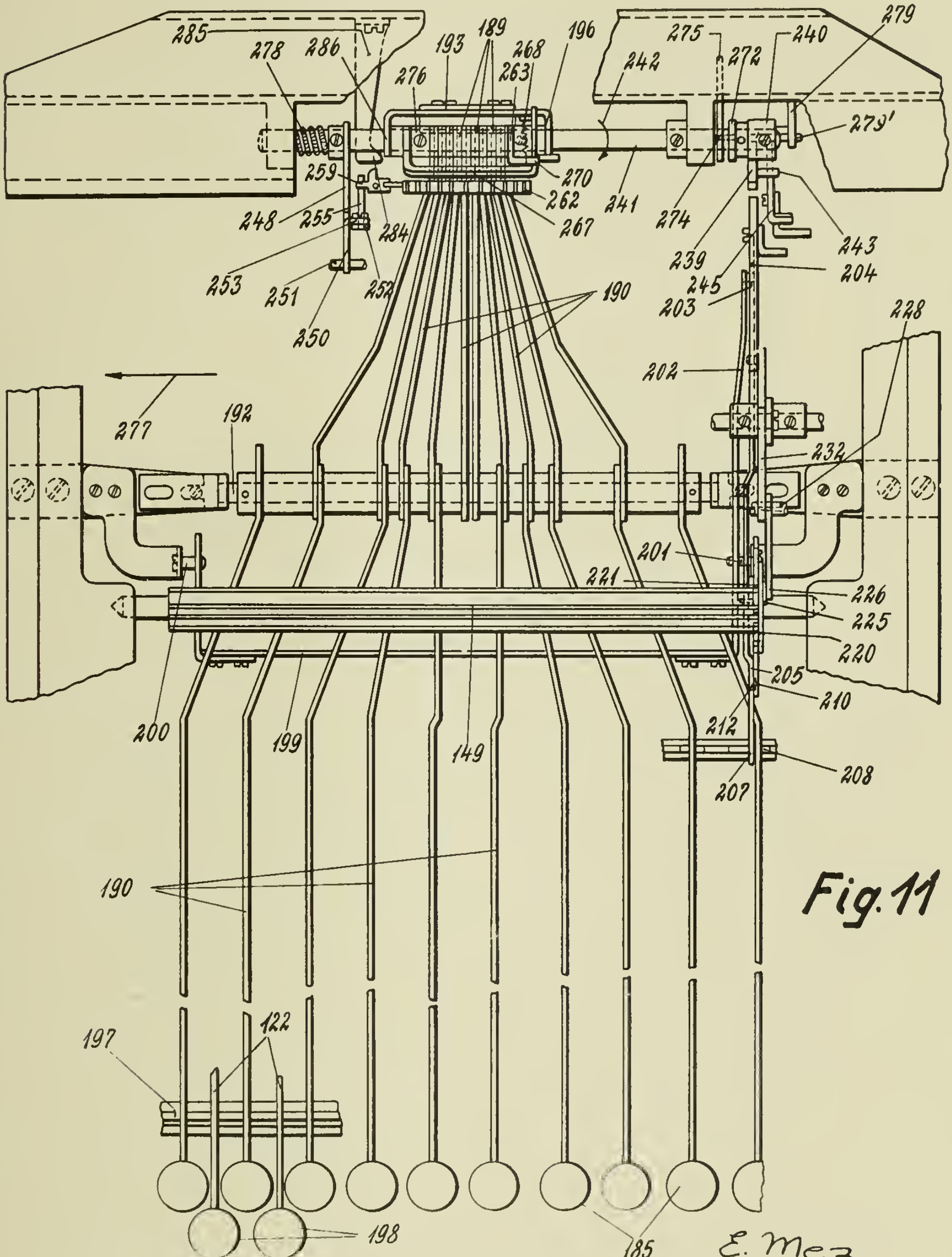

Fig. 11

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Fig. 12

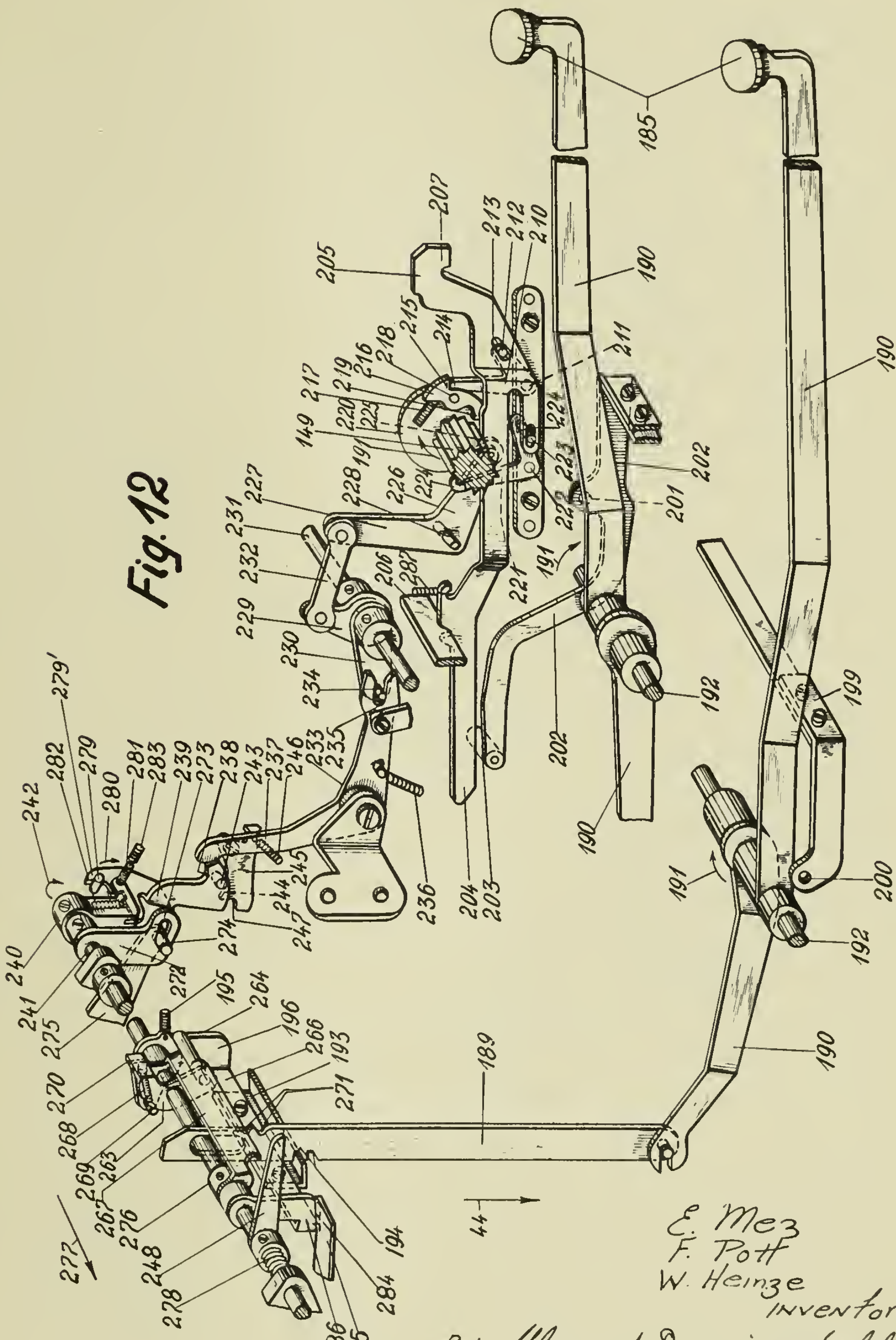

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Fig. 15

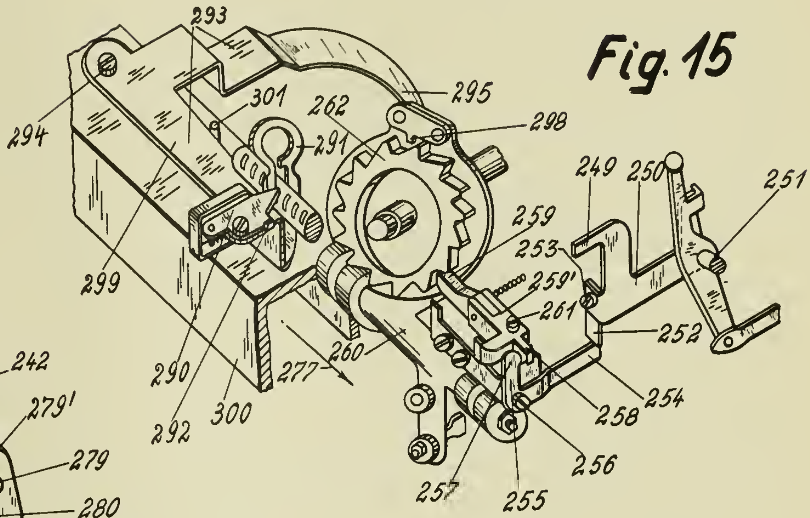


Fig. 13

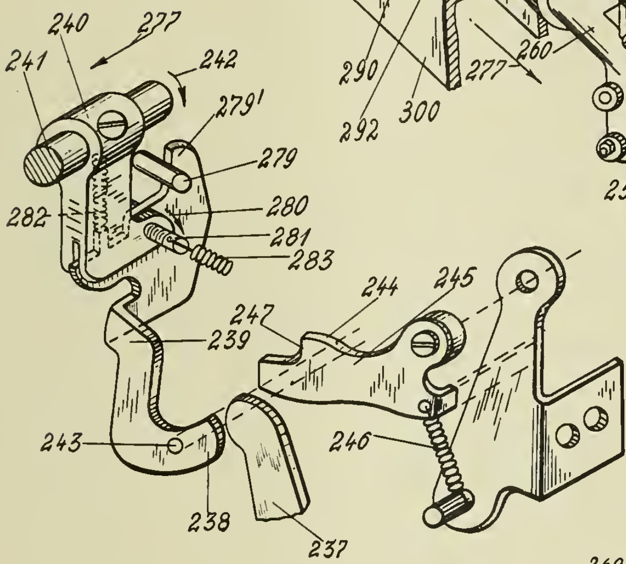
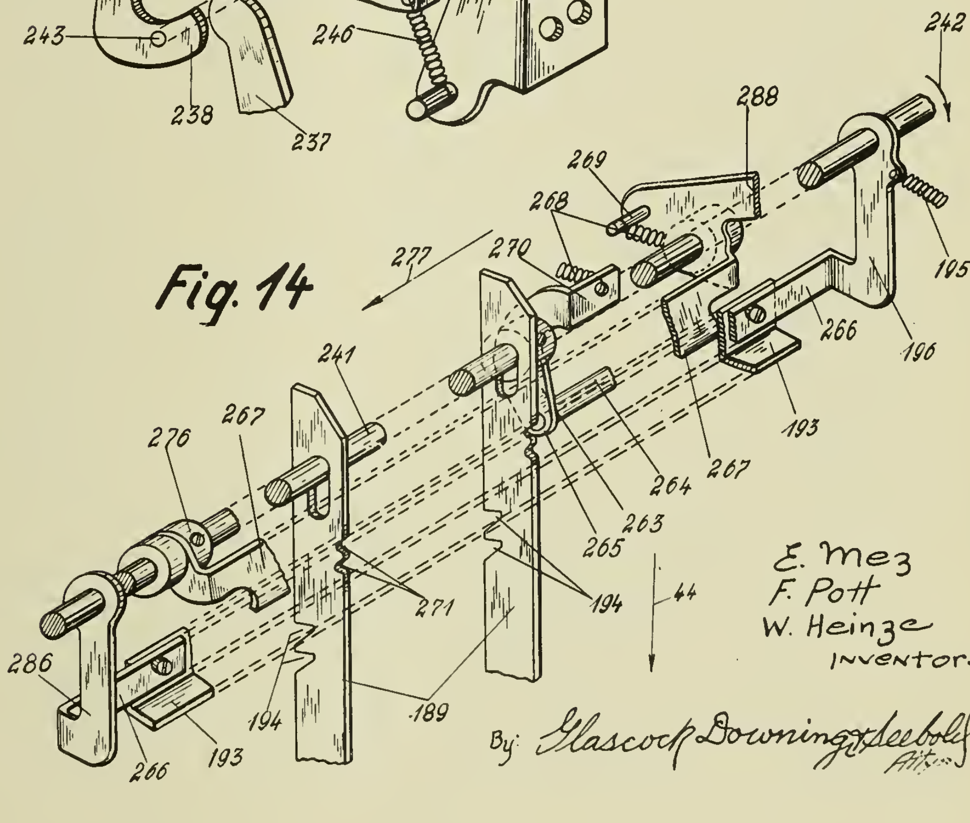


Fig. 14



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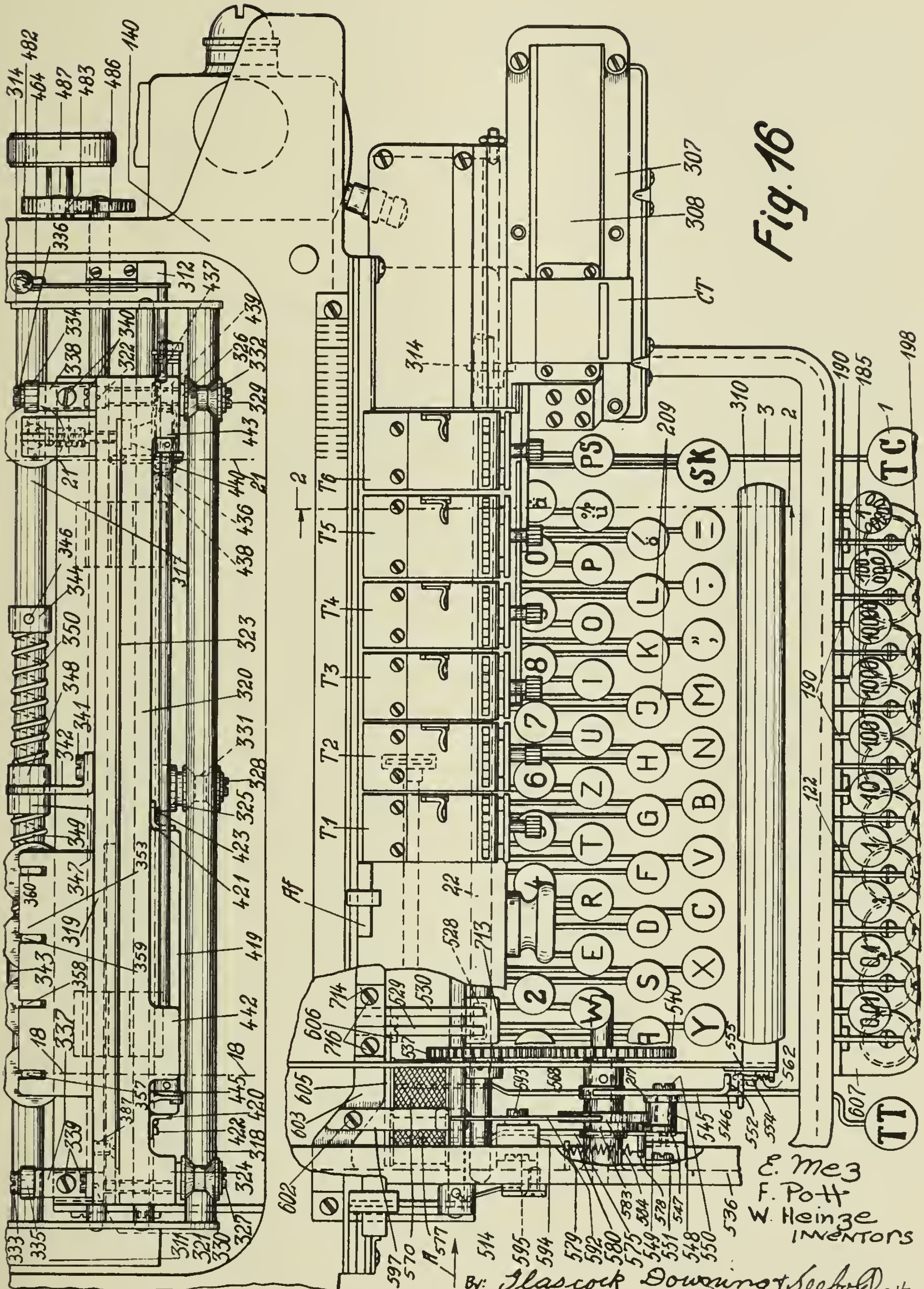

Fig. 16

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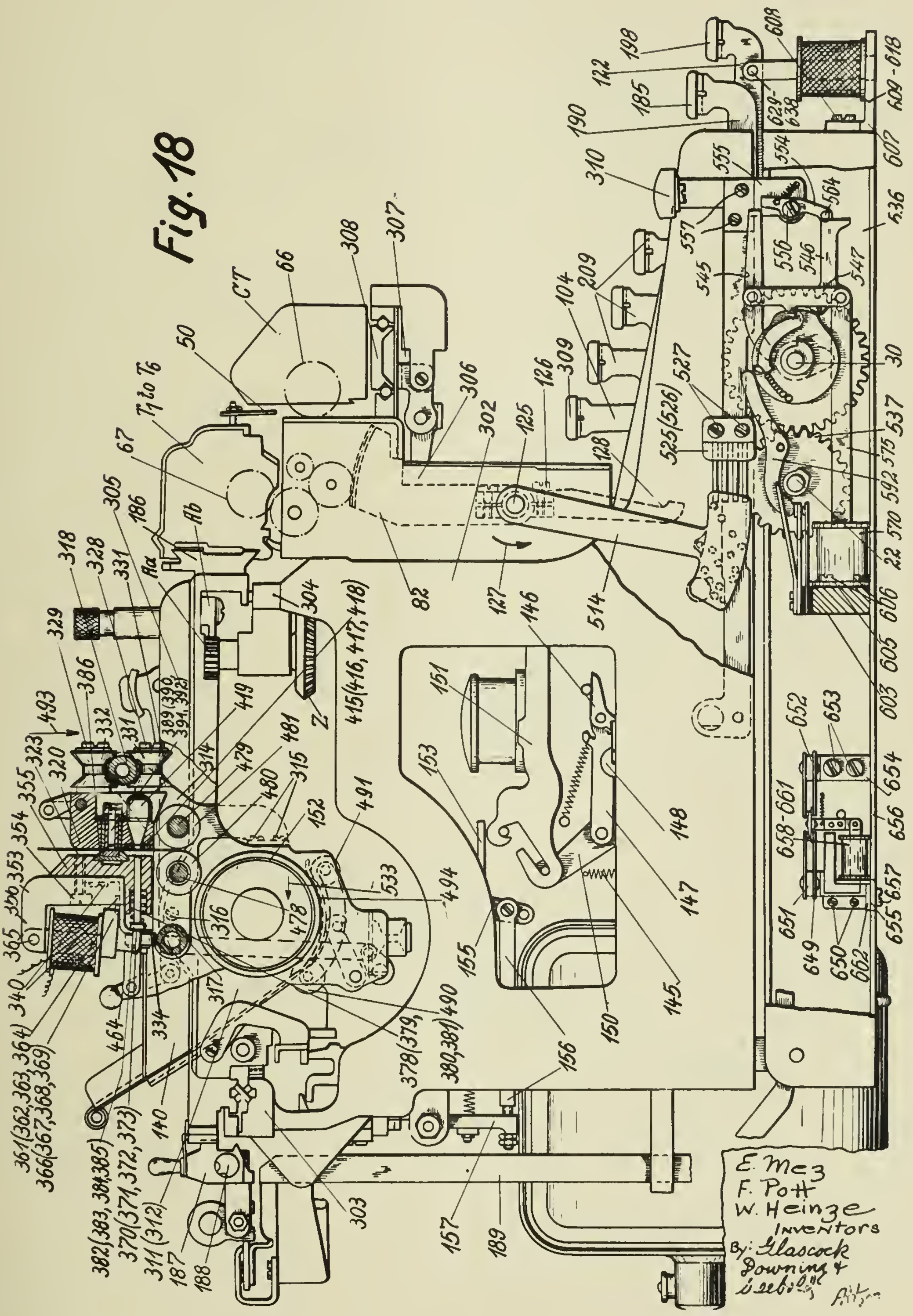

Fig. 18

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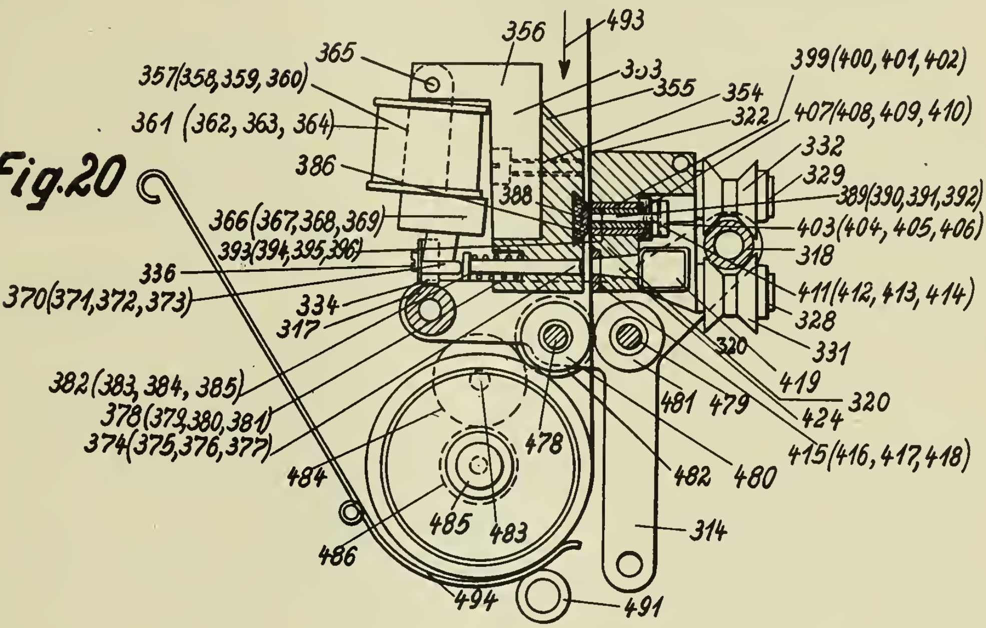
Fig.20



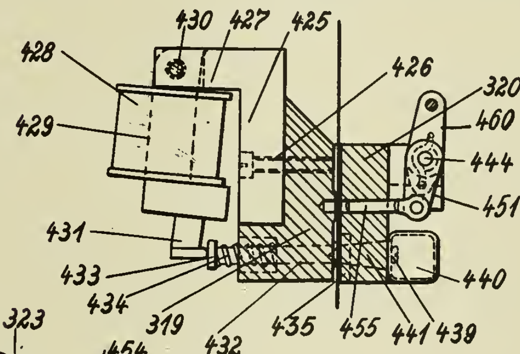


Fig. 21

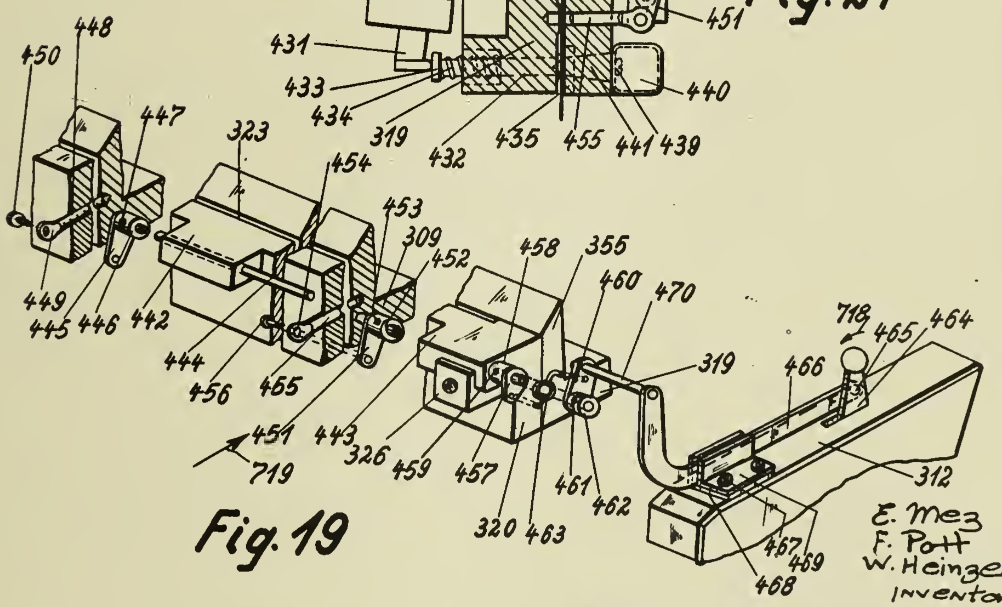


Fig. 19

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E. MEZ ET AL
PROCESS FOR THE REGISTRATION
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Fig. 23

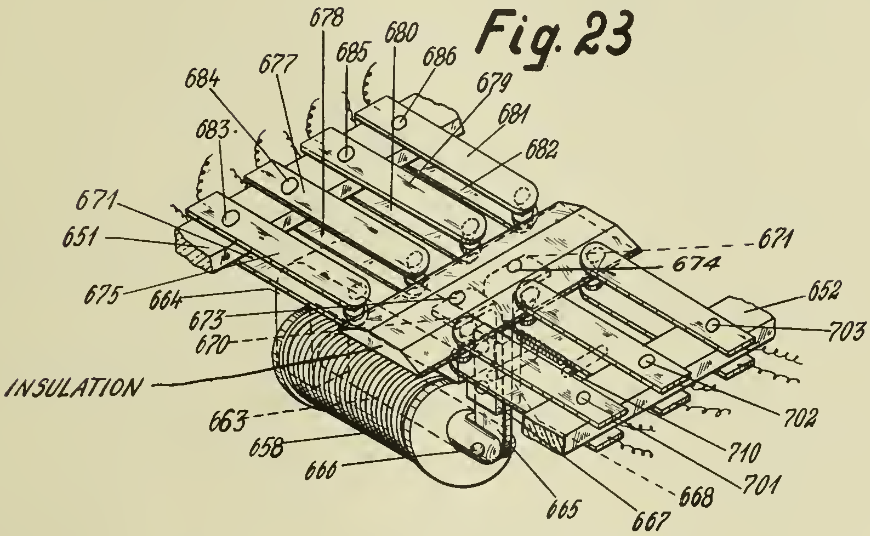

Fig. 22

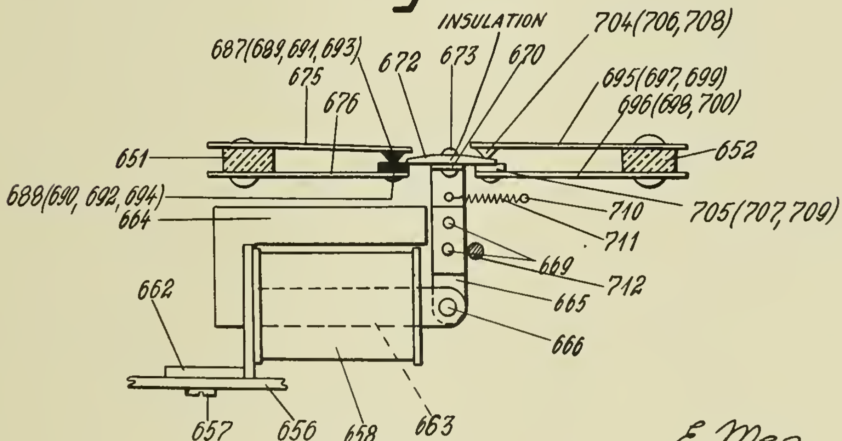

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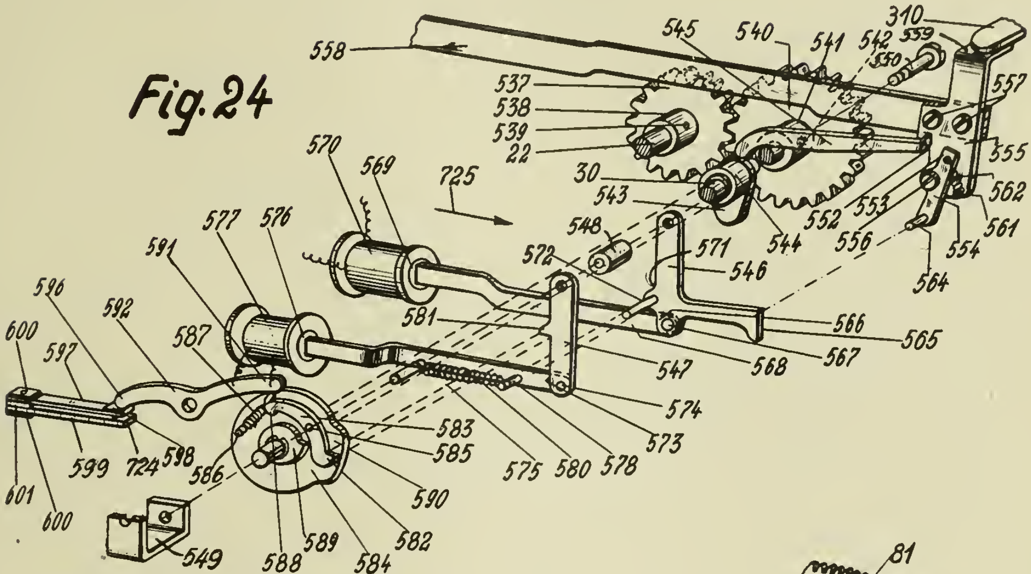
Fig. 24



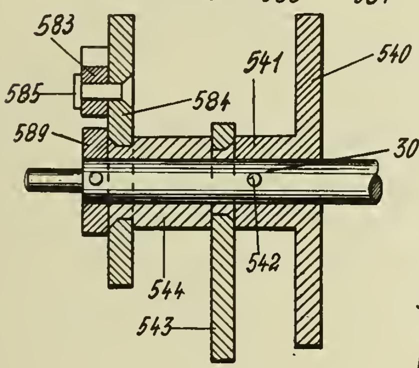


Fig. 25

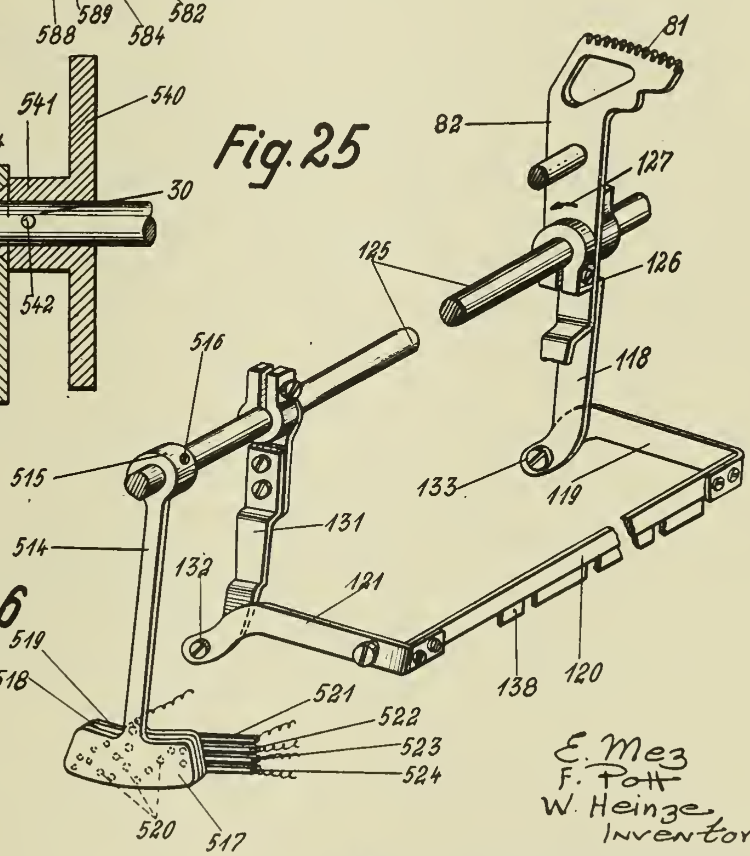


Fig. 26

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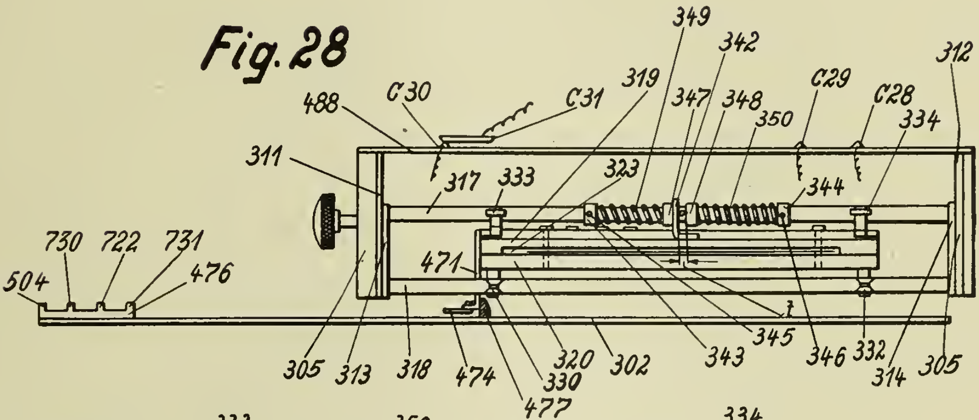
Fig. 28



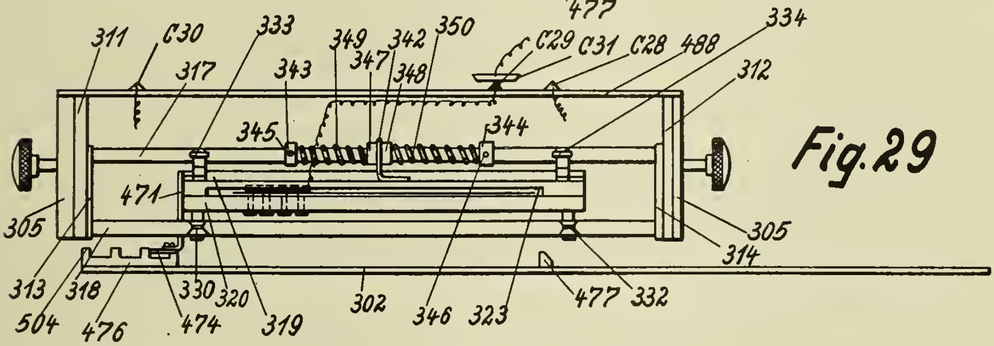


Fig. 29

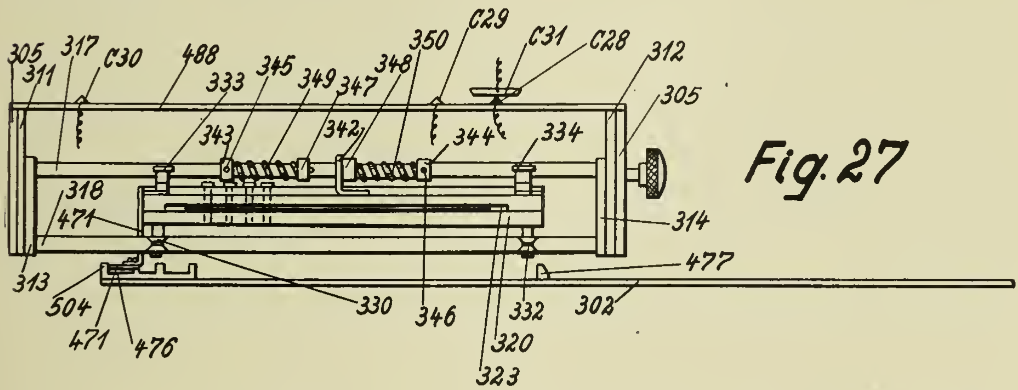


Fig. 27

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Fig. 30

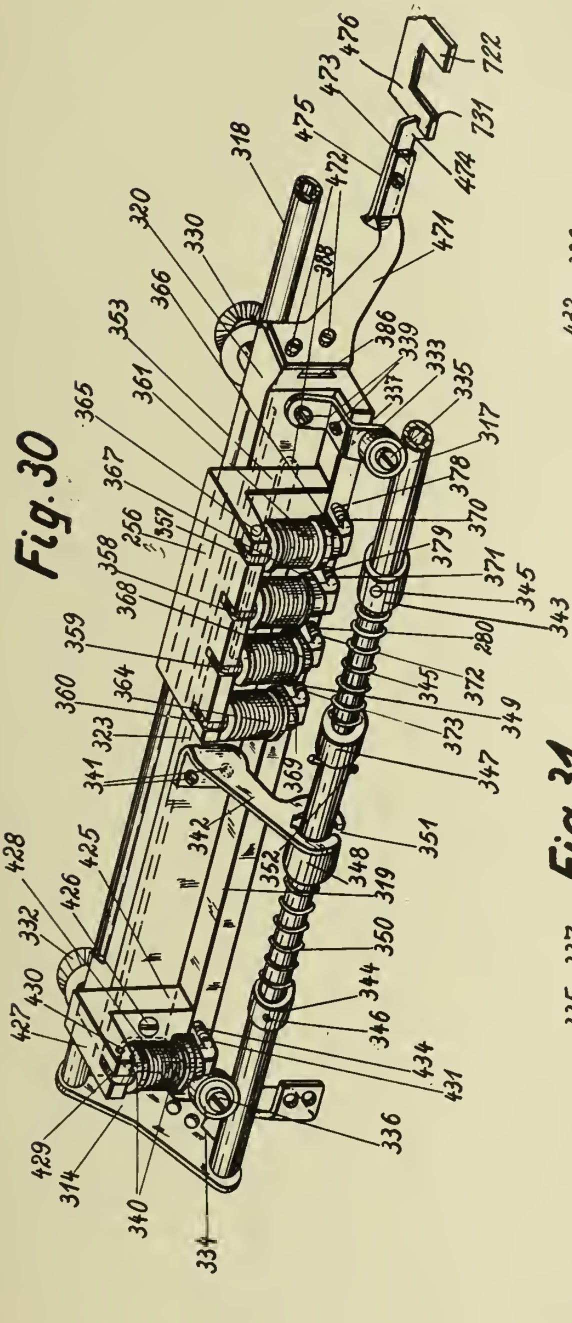

Fig. 31

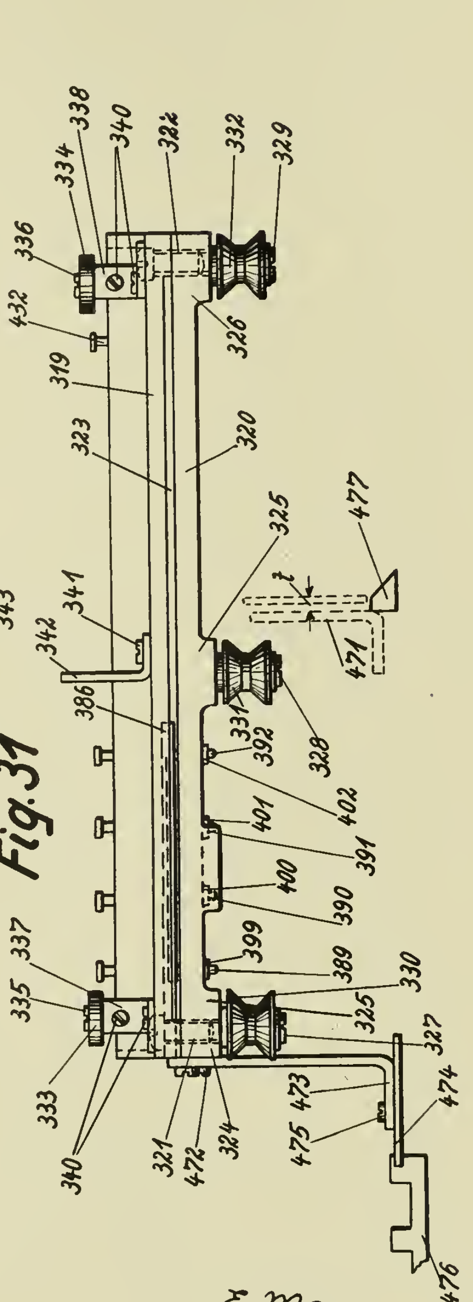

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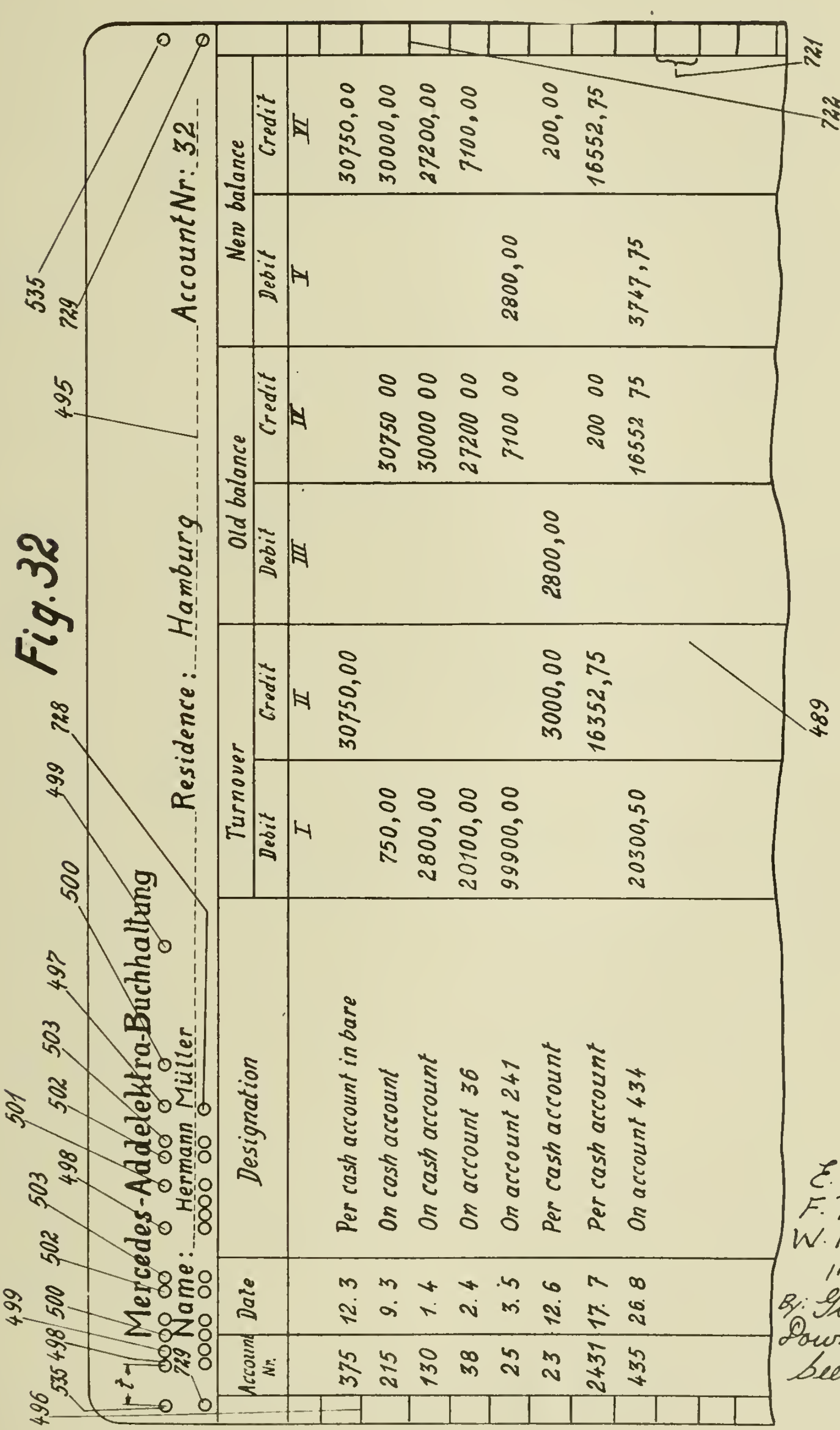
Fig. 32



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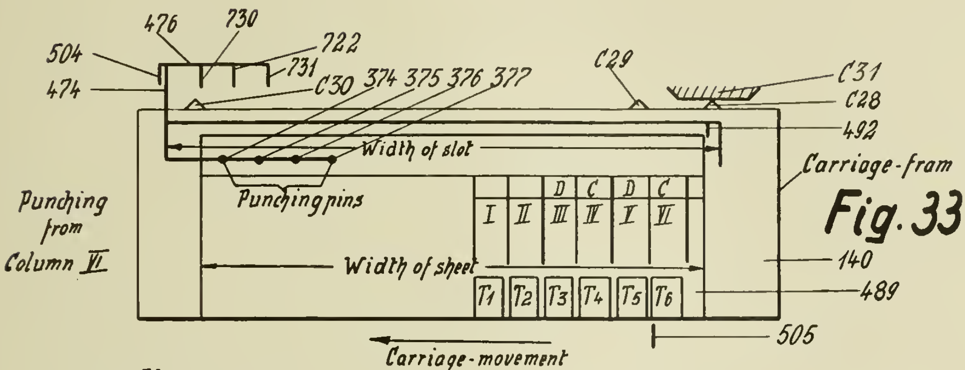


Fig. 33

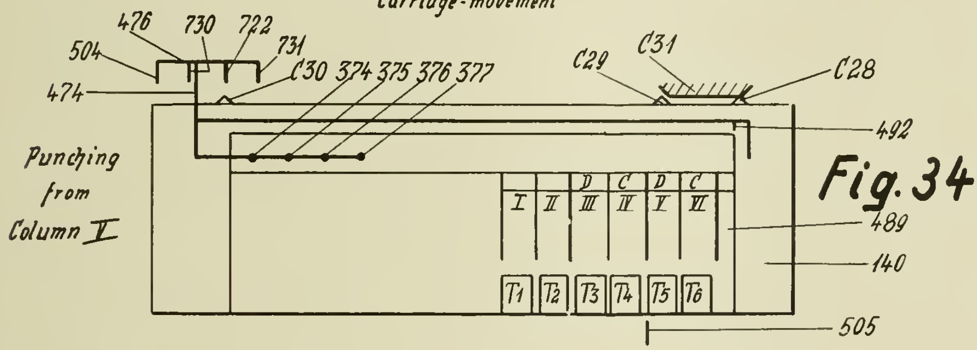


Fig. 34

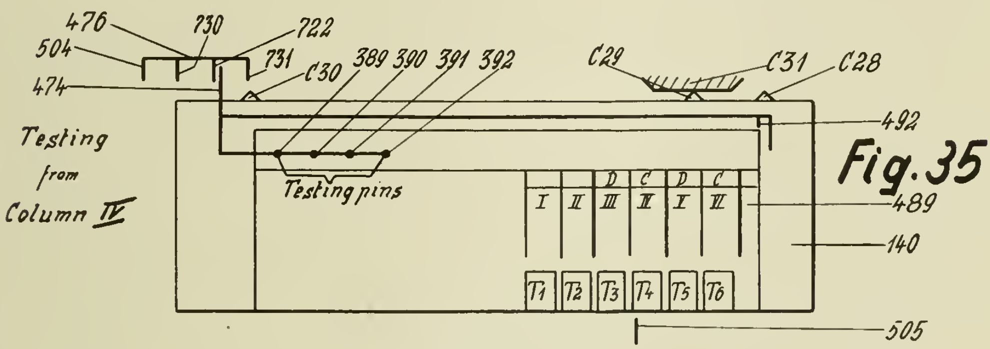
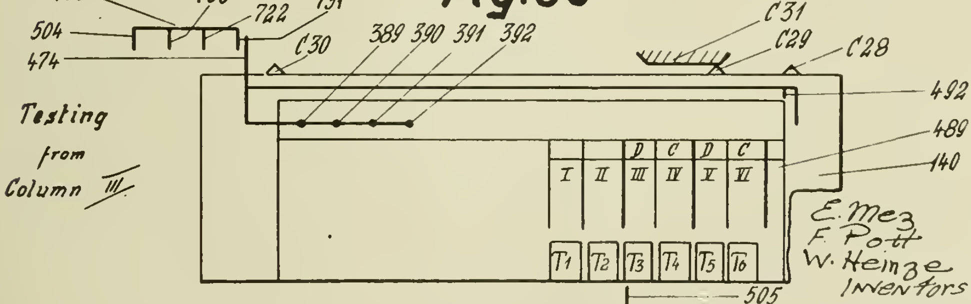


Fig. 35

Fig. 36



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Punching
Value 30750,00

Fig.37.

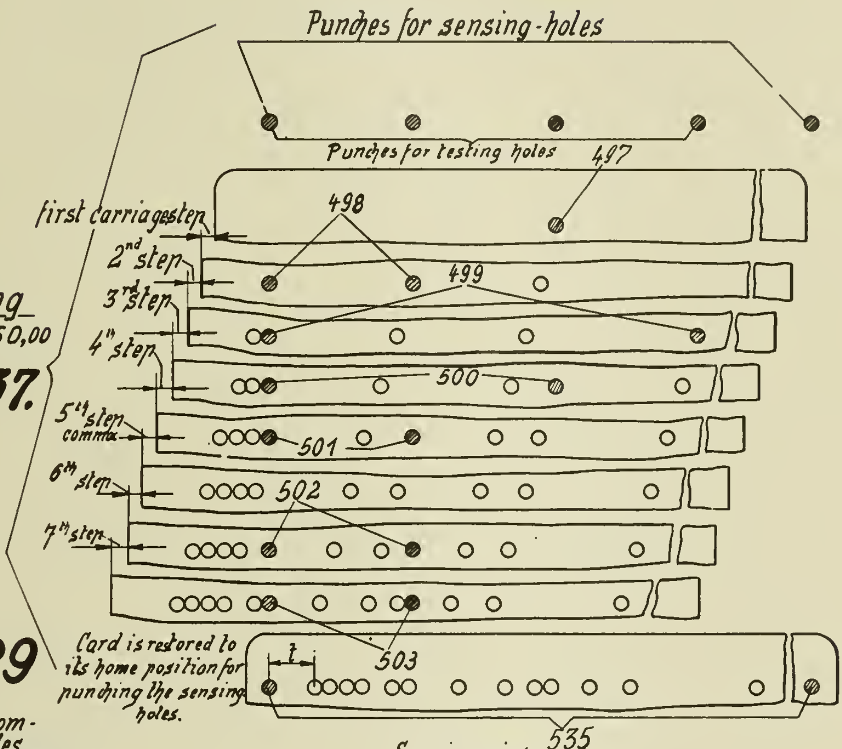


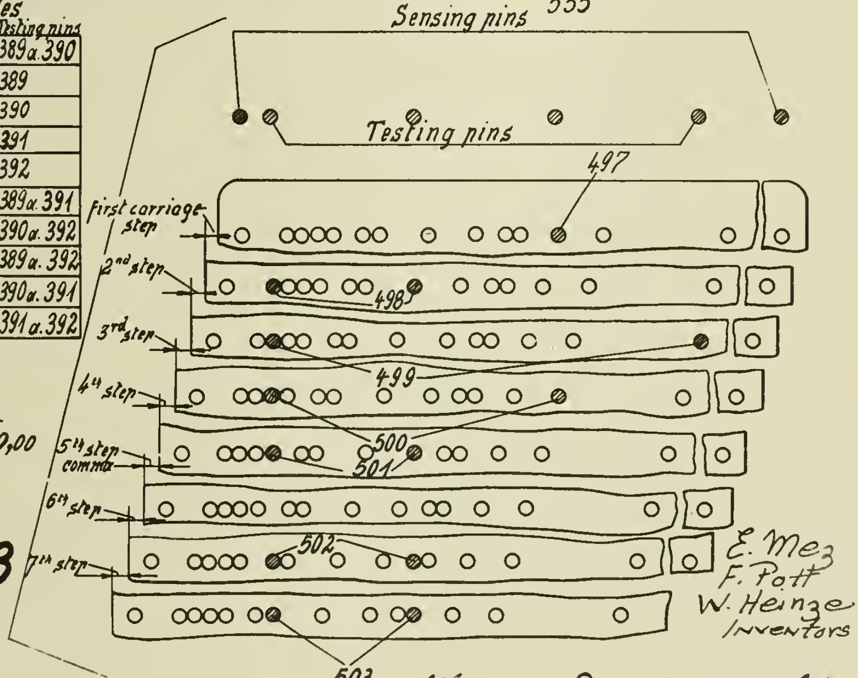
Fig.39

Key for the combination of holes

	Punches	Testing pins
0=	374 a 375	389 a 390
1=	374	389
2=	375	390
3=	376	391
4=	377	392
5=	374 a 376	389 a 391
6=	375 a 377	390 a 392
7=	374 a 377	389 a 392
8=	375 a 376	390 a 391
9=	376 a 377	391 a 392

Testing
Value 30750,00

Fig.38



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PROCESS FOR THE REGISTRATION

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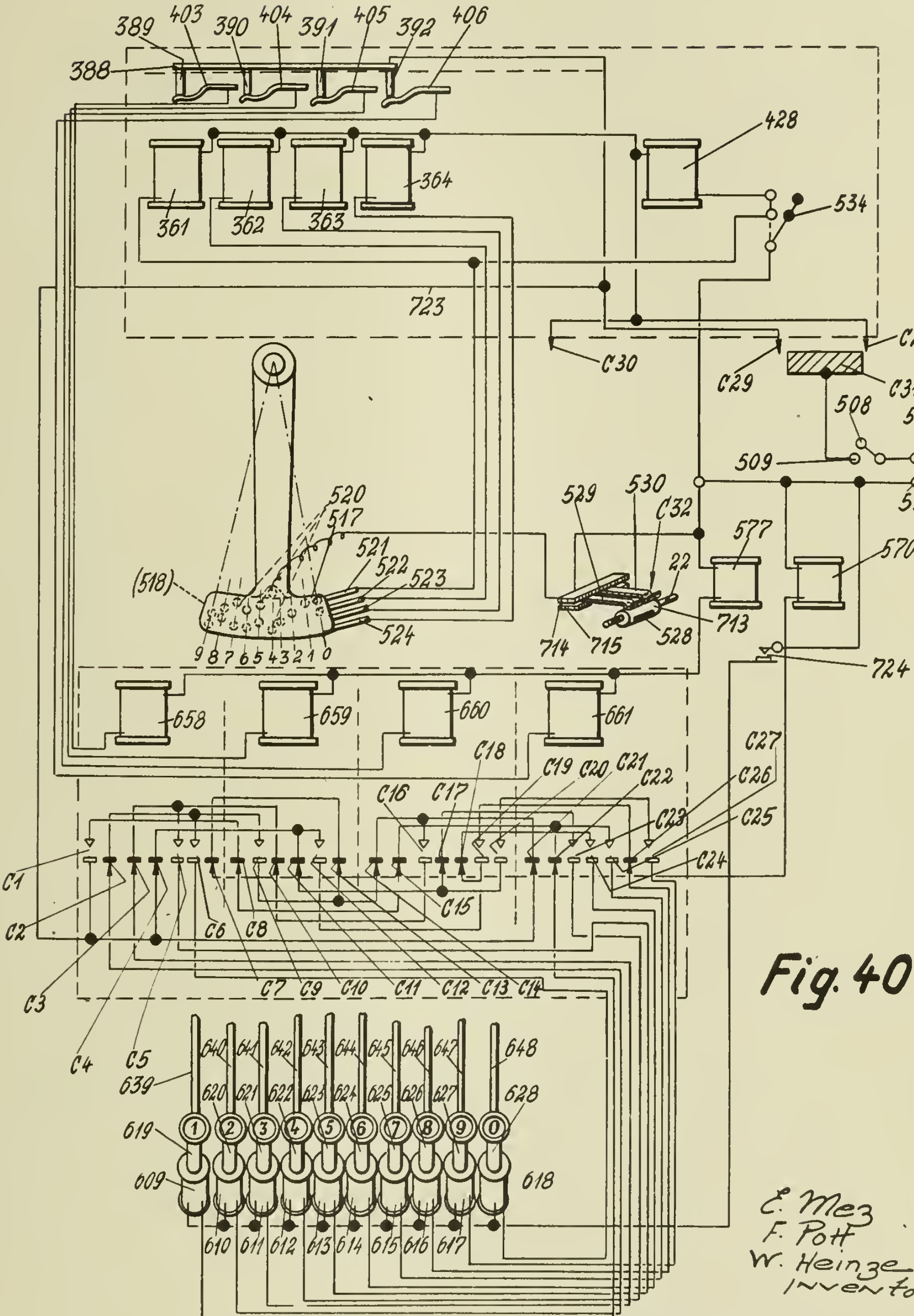

Fig. 40

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PROCESS FOR THE REGISTRATION
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Fig. 41

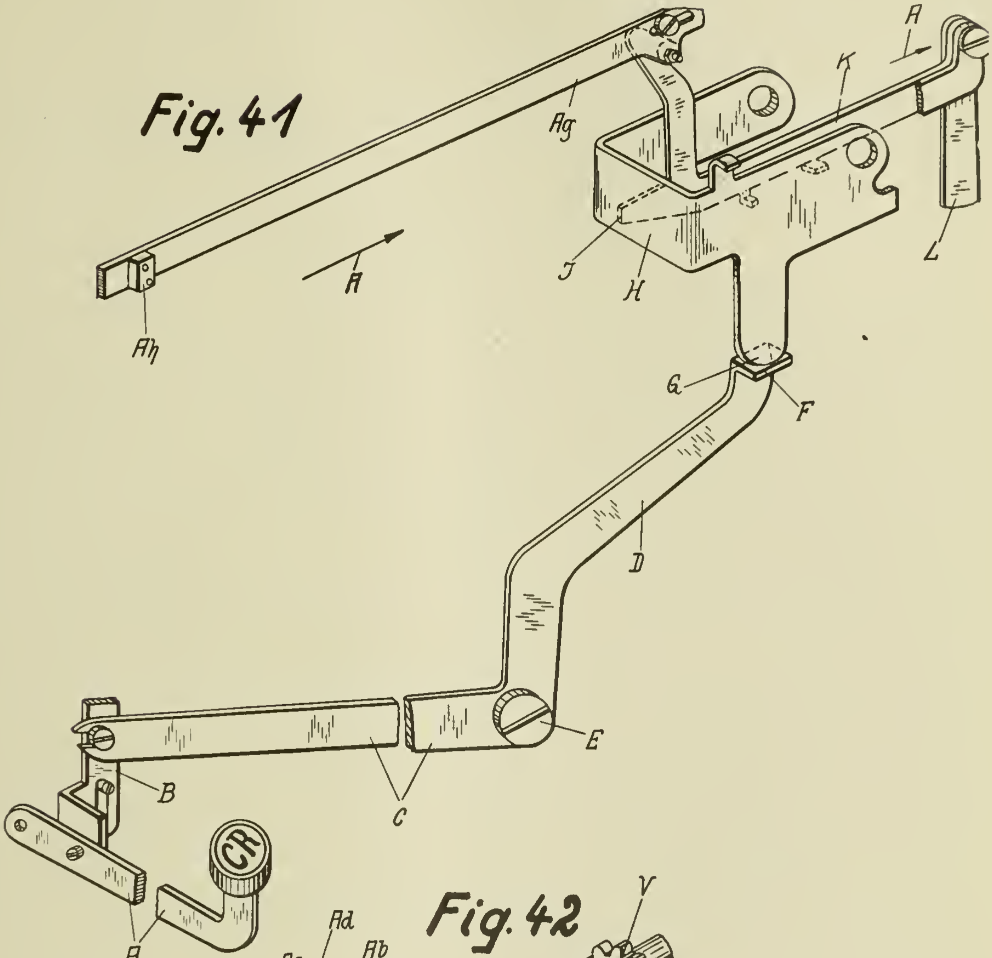
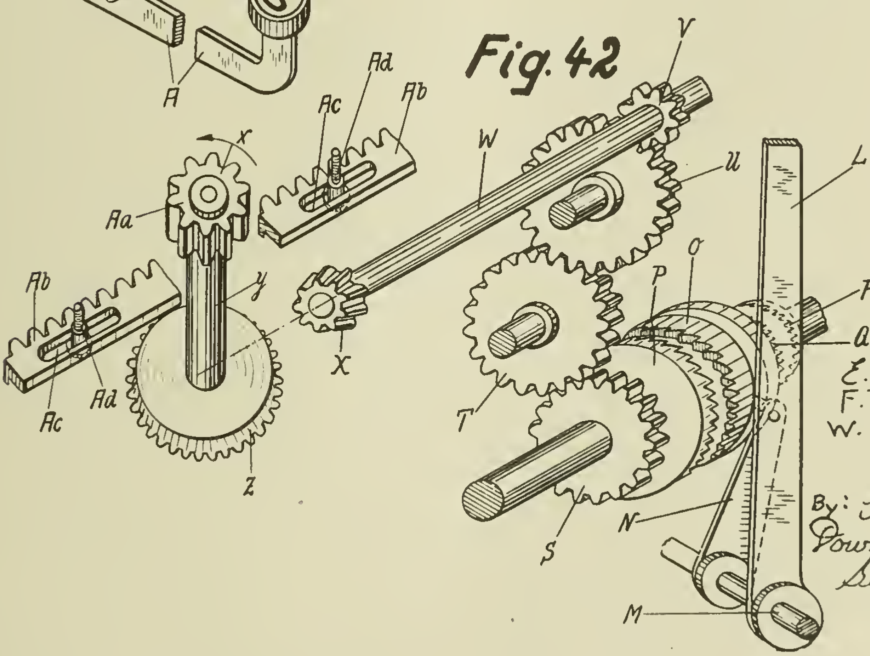


Fig. 42



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Published May 25, 1943

Serial No. 90,702

ALIEN PROPERTY CUSTODIAN

CATHODE RAY TUBE CONTROL CIRCUITS

Wolfgang Federmann, Berlin, Germany; vested in the Alien Property Custodian

Application filed July 15, 1936

The invention relates broadly to a circuit arrangement for controlling the production of a cathode ray beam in cathode ray tubes employed, for instance, as transmitting or receiving tubes in television arrangements and more specifically to a circuit arrangement whereby the cathode ray beam, which has been deflected to some point in its line of deflection, is returned to an initial position and the production of the beam is blocked during the return period.

In a specific embodiment of my invention, a condenser is charged in a linear fashion and simultaneously the deflecting members of the cathode ray tube deflect the beam in one direction in accordance with the magnitude of the charge on the condenser. At predetermined intervals, a discharge path joined in parallel to the condenser is rendered conductive by electrical impulses allowing the condenser to discharge its stored charge, either completely or to a predetermined degree. The discharge of the condenser effects a drop in potential across an electrical element connected thereto and this drop is fed to a control element of the cathode ray tube blocking the beam. Simultaneously therewith the discharge in the condenser effects the return of the beam to an initial point.

As applied to the use of such a circuit in a television arrangement, during the storing period, the condenser effects the movement of the beam for a space corresponding to the one picture line and the beam may be modulated simultaneously with picture signals when the beam has reached the end of the line, the discharge of the condenser is initiated by supplied electrical impulses and the discharge is used to develop a potential which blocks the cathode ray, and the discharge itself is used to return the beam to a position corresponding to the beginning of a line of the picture. The invention will best be understood by reference to the figures in which:

Figure 1 represents one embodiment of my invention.

Figure 2 shows a series of curves representing potentials in the circuit with respect to time and

Figure 3 is another embodiment of my invention.

Referring to Figure 1, **10** is an electrical condenser used as a storage element which is charged in a linear fashion by the anode voltage supply **14** (not shown) the negative terminal of which may be grounded which charges the element **10** through a resistor **13** and a resistor **11**. The anode-cathode path of a thermionic tube **12** is joined in series with the condenser **10** and the resistance element **11**, and this combination is grounded at the cathode of the tube. The anode of the tube **12**, together with one plate of the condenser **10**, is joined to the deflecting means **16** and the cathode ray tube through a blocking condenser **15**. Shunted in parallel to the deflecting plates of the cathode ray tube is a resistance element **17**. The cathode ray tube itself also includes the grounded cathode **18**, a control grid **19**, which may also be constructed as the Wehnelt cylinder, and an anode **20**. At the point where the resistance element **11** joins the condenser **10** there is a connection joining this point or junction to the grid **19** of the cathode ray tube through the secondary of a transformer **21** whose primary is adapted to be energized by picture signals for modulating the cathode ray beam. The cathode of the thermionic tube **12** is joined to a control grid of the tube through a biasing battery **25** which normally maintains the tube in a non-conductive state, and an electrical element across which input signals to the tube may be impressed. The circuit in this figure operates in the following manner.

At the time t_0 the condenser may have a zero charge or a base charge. The condenser is charged in a linear fashion in accordance with the value of the resistor **13** and resistor **11** by the anode supply voltage of the thermionic tube up to a time t_1 at which time a positive pulse is applied to the grid of tube **12** which is normally blocked. As a result of the positive pulse, the thermionic tube **12** becomes conductive and the condenser **10** discharges across the resistor **11** and the anode-cathode path of the tube. For the sake of simplicity, reference should be made to Fig. 2 which shows the shape of the discharge curves. The condenser dscharges during the period t_1, t_2. At the time t_2, the charge on the condenser **10** has again dropped to its base value, which may be zero, and if at this time the positive pulse applied to the grid of tube **12** has ceased, then the condenser will again start to charge as before.

While the condenser is charging and discharging, the changing potentials across the resistance element **11** are impressed through the blocking condenser **15** to the deflecting plates **16** of the cathode ray tube, thus effecting a deflecting of the beam in a linear fashion.

Referring to Fig. 2, the relationship between the various waves with reference to time is clearly brought out, but for the sake of comparison, the positive impulses applied to the grid of the thermionic tube **11** are shown below the base

line. As shown, the positive pulse begins at the time t_1 and lasts until the condenser has discharged to its base value at the time t_2. The lower portion of the figure brings out the linear charge and discharge wave of the condenser and hence the potential drop across resistor 11. The positive pulse naturally must have a value greater than the difference between the cut-off voltage of the thermionic tube 12 and the value of the biasing battery 25 or else the tube will not be rendered conductive thereby. If, due to inherent inductive effects in the output circuit of the thermionic tube 12, the condenser charge would not be strictly a linear function, then this may be compensated by the wave shape of the positive impulses impressed on the grid of the thermionic tube 12 and such is illustrated by the dotted portion, that is to say, that the fact that compensation for non-linearity may be accomplished in such a fashion.

Referring to Fig. 3, a choke coil 22 supplants the resistor 11, shown in Fig. 1, and a detector is connected in parallel to said choke coil. During the charging of the condenser 10 a voltage is built up across the choke coil which is short-circuited by detector 23 so that the control grid during the time of charging receives only the picture impulses applied to the transformer 21. A constant bias is supplied by the voltage source 24.

During the time t_1, t_2, that is, when the condenser is discharging, the upper end of the choke coil 22 becomes negative with respect to the lower end and consequently, the detector 23 is inoperative and this voltage is impressed on the control element 19 in the cathode ray tube and acts as a blocking voltage. Since the beginning of the charging performance of the condenser 10, the choke coil 22 may oscillate at its natural frequency, and these oscillations may cause a singular or multiple blocking of the cathode ray at a time shortly after the time period t_0, the detector 23 acts as a short-circuit to prevent these oscillations and hence multiple blocking is avoided thereby.

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CATHODE RAY TUBE CONTROL CIRCUITS

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Fig. 1

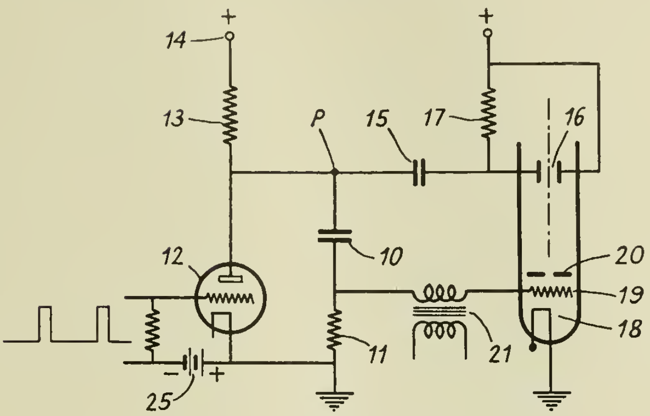


Fig. 2

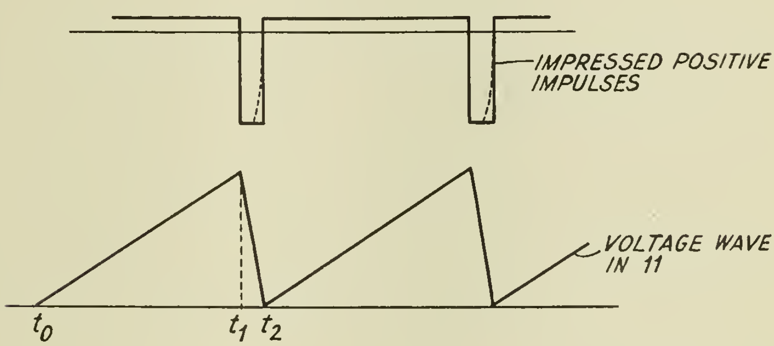
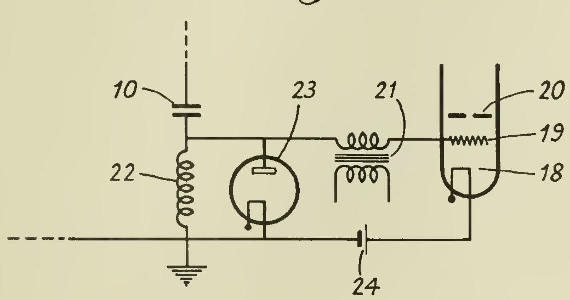


Fig. 3



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Published May 25, 1943

Serial No. 107,398

ALIEN PROPERTY CUSTODIAN

MANUFACTURE OF SOAP

Adolf Welter, Krefeld-Rheinhafen, Germany; vested in the Alien Property Custodian

No Drawing. Application filed October 24, 1936

My invention relates to the art of soap making and more especially to a process for the manufacture of powdered or molded soaps which are free from alkaki carbonate and do not effloresce.

It is known to those skilled in the art of soap manufacture, that fatty acids free from neutral fat can be converted in a very short time with dry calcined soda in powder form into a homogeneous soap. The fatty acid must be as free from water as possible; the mixture with the soda must take place at a temperature only slightly exceeding the melting point of the fatty acid and an amount of soda exceeding the quantity theoretically necessary for saponification must be used, but if it is desired to obtain soda-free soaps, double the theoretical amount should not be exceeded or should be only slightly exceeded. In addition to a completely water-free soap, neutral sodium bicarbonate is formed in the reaction.

The difficulties encountered in this profiitable saponification process are that one is limited to the use of fatty acids having a not too high iodine value and that for the transformation of the saponification products into readily soluble products such as flakes, strips, chips and threads and also for the manufacture of ground and pressed soaps one must admix some other liquid, water-containing soap. For, if fatty acids with a higher iodine value are employed, the soaps obtained, owing to their neutral character and their deficiency in water, very easily become rancid or, if they are unsuitably stored in large quantities, oxidize to such an extent that they may even become completely carbonized. The lack of plasticity and softness of the product must be obivated by the addition of considerable amounts of water-containing soaps, for example liquid curd soap. This process, however, requires a circumstantial mixing operation and necessitates a frequent passing of the mixture through the pressure rollers.

I have now found that the aforesaid disadvantages can be obviated if water in quantities of about 2–50% calculated on the fatty acid, and preferably at room temperature is added in a suitable manner to the mixture of fatty acids and calcined soda or potash. This addition also brings about a more rapid saponification and leads to altogether homogenous products with a water content which can be accurately adjusted and which are capable of being comminuted without any drying or further addition of water. The reaction produdcts can also be mixed as desired with anhydrous or water-containing liquid or solid soaps, saponification products, other dispersing or wetting agents, paraffin, vaseline, waxes, solvents, per-compounds or other of the usual additions or filling agents which are added to soap.

The amount of water added varies within wide limits and is dependent on the kind of soap (whether it is a potash or a soda soap, and whether from liquid or solid fatty oils), on whether salts are used as well, on the kind of molding, and on the later admixture of curd or filled soaps which may take place. In the case of soda soaps 20–30% at the most is taken, while with potash soaps the amount is from 2–5%.

Instead of pure water, salt solutions may be employed and thereby a soap having a definite addition of salt can be manufactured. For this purpose, salts are added in any suitable proportion which do not decompose the bicarbonate. The water or the aqueous salt solution can only be added to the mixture of fatty acid and alkali carbonate without impairing the saponification process, while at the same time obtaining uniform and compeltely saponified products, when the mixture of the two is an altogether homogeneous one. I have found that contrary to expectations very considerable amounts of water or aqueous salt solutions can be added without separation of the constituents and without the homogenity of the saponified mass being impaired. On the contrary with these additions as a rule a far more homogeneous product is obtained than without them. Oxidizing or reducing bleaching agents such as sodium perborate, sodium hypochlorite, sodium hydrosulphite, sodium persulphate or the like may be added to the water or to the salt solutions which are added during the saponification.

When operating without an addition of water and salt trouble is experienced even in the case of charges containing more than 300–500 kgs of fatty acid, owing to insufficient mixing and the tendency to strong internal overheating. For this reason, the soap from the mixing vessel which was spread on the floor had hitherto to be broken up with the spade as quickly as possible in order to effect better cooling, since otherwise a strong discoloration occurred or, if soft fats with a medium iodine value were used, combustion even took place. In contradistinction thereto, if water or aqueous salt solutions are added during the saponification process, any desired charges of fat of several thousand kilograms can be stirred up at a time and can be spread on the floor without being broken up because

overheating owing to oxidation is no longer to be feared. Further, the stirring mechanism may be of considerably lighter construction since the reaction mass is considerably less brittle than one without the additions. The new process further makes me independent in the choice of raw materials. By it for example ground soap can be manufactured solely from coconut oil fatty acid or solely from hard fats or also only from soft fats, so that I am not limited in the choice of material and can select it to suit market conditions.

With the addition of water or of salt solutions the above process also proceeds so smoothly and completely that it may even be carried out continuously. In this case I proceed in such a way that, after the fatty acid has been mixed with the alkali carbonate and the water or salt solution added, the solidified reaction mass which is no longer sticky is passed, for example through a mill in order to convert it into thin, fine strips. The mass thereby becomes so homogeneous that a quantitative saponification is completed in an astonishingly short time. The mass at the same time heats up so strongly that it still remains plastic for some time during which it can be shaped into bars or pieces or also into bands, chips, flakes or threads in an entirely continuous manner. In special cases I may also heat the rolls during the first part of the process or I may shortly before the molding, if necessary, cool the reaction mass down again to the most suitable molding temperature by cooling the rolls. I have even found that in this continuous process, even if the saponification process has not yet proceeded absolutely quantitatively, an after-saponification occurs within a few hours which in no way impairs the appearance of the product which, no doubt, is mainly due to the fact that the water and the carbonic acid formed during the saponification reaction are consumed quantitatively in the formation of alkali bicarbonate. Cracking or efflorescence of the molded products does not occur. Instead of rolls worms may be used for the further treatment of the mixture.

It is true that in the known process the attempt has already been made to mix fatty acids with soda containing up to 30% water of crystallization but this process has not proved successful in practice. For the moment when the addition of water is made, is of decisive importance. If the water is present right from the start, insuperable difficulties oppose the smooth course of the saponification. In the first place its is very difficult to manufacture a soda in the form of a fine powder which contains water of crystallization such as is necessary for a sufficiently thorough mixture. Such a soda further cakes together again after quite a short time and must be ground and sieved afresh before each saponification operation. Finally saponification takes place so quickly with soda containing water of crystallization that the previous thorough and uniform mixing, which is absolutely necessary, cannot be obtained. There are therefore formed useless mixtures of soda, soap, fatty acids and bicarbonate.

I will now proceed to describe the new method of saponification according to the present invention. In a vessel which is made, for example, of aluminium and has an efficient and suitable stirring mechanism the fatty acid is very thoroughly mixed in a short time at a temperature of about 30–35° C. with double the amount of calcined soda necessary for the saponification. Thereupon water, however not more than one half of that calculated on the amount of fatty acid employed, is quickly poured in whereby the whole mass is rapidly heated up and saponified within about two minutes to form a soft product. When this product has solidified under stirring to such an extent that it no longer cakes on the walls, the vessel is emptied and a new charge is introduced into it. It is more advantageous to use salt solutions instead of water or, if one desires to obtain, for example later after the addition of curd or filled soap, a product which is capable of being comminuted without drying, suitable salts dissolved in their own water of crystallization. After some hours and sometimes on the next morning the soap can be molded with or without further addition of liquid curd or filled soaps, either according to the grinding process into the form of skeins or pieces, or can be converted in a known manner into strips, chips, flakes or threads or ground to powder. If soda-free neutral soaps shall be obtained, only those salts should of course be employed which do not decompose alkali bicarbonate. For this purpose sodium bicarbonate, disodium phosphate, neutral sodium pyrophosphate or borax are particularly suitable. The addition of the said phosphates moreover exercises a stabilizing effect on the products. If salts which decompose bicarbonate were employed, alkali carbonate would again in part be formed, so that the soap would not only assume an alkaline character, but would also not be stable in contact with the air and would exhibit efflorescence.

Obviously, during the saponification process any desired fat solvents and also resinic acids may be added to the fatty acids, and the soda may be replaced by equimolecular quantities of potash or mixtures of soda and potash. The admixture of fat solvents is particularly to be recommended when the fatty acid to be employed has a too high melting point. As low a moisture content in the fatty acid as possible is of importance in order that the intimate mixing may be carried out without the saponification process being started too soon by any moisture which may be present. The new process is the only process known up till now by which solid, shaped and homogeneous soaps having a hydrocarbon content can be obtained without a drying process being required, which will always lead to a loss of hydrocarbons.

The properly manufactured soaps contain only sodium bicarbonate and are practically neutral. They are therefore particularly suitable, for washing, more especially at room temperature or at a somewhat higher temperature, sensitive fabrics above all wool and silk, and also for bodily use. When washing linen, i. e. under boiling, the sodium bicarbonate is decomposed into sodium carbonate and carbon dioxide which develops slowly in the material under treatment and greatly contributes to the quick and complete removal of the dirt which has been loosened. By the formation of bicarbonate or the addition of salt solutions the fatty acid content is reduced as compared with that of the pure soaps which is desirable for many purposes on technical grounds. In other cases the fatty acid content can again be increased by the admixture of pure, solid and liquid filled or curd soap.

In practicing my invention, I may for instance proceed as follows:

Example 1

400 kgs. of distilled fatty acid consisting of
33% palm oil faty acid,
33% palm kernel oil fatty acid,
34% earth nut oil fatty acid,

are mixed at 30–35°C in a suitable mixing vessel of aluminium or silumin with 168 kgs of calcined soda of 99% which takes about 1 minute. After this 100 kgs of water are added, whereupon the mass solidifies within a further minute, forming a white soap which no longer sticks together and can be easily detached from the walls of the vessel. The vessel is easily emptied by tipping without any remainder being left therein. After the addition of 0.2% of a rose perfume the saponified mass may then be banded one to two times and may be pressed directly in a single operation into smooth, glossy strands, threads, flakes, chips or the like. The soap dissolves clearly at 34–40°C and has a turbidity point of 31°. The fatty acid content of the soap amounts to 70–71%. The pieces obtained from the strands by pressing exhibit a beautiful lustre, remain unchanged in contact with air and possess a high foaming and cleaning power.

Example 2

400 kgs distilled fatty acid, composed of
30% palm oil fatty acid,
30% palm kernel oil-coconut oil fatty acid,
40% earth nut oil fatty acid,

are intimately mixed for about 1 minute at a temperature of 30–35°C and with the addition of some perfume with 168 kgs calcined soda of 99%, after which the mass is altogether homogeneous. Now 100 kgs water, into which 12 kgs sodium bicarbonate and 4 kgs tylose have previously been stirred at about 30–60°C, are added, whereupon an almost complete saponification takes place at once, the temperature rising from 30° to 75–80°C. The mass can be banded at once and then shaped, as in Example 1, to form strands, pieces, threads, flakes or the like.

Example 3

To 400 kgs distilled fatty acid as indicated in Example 2 are added 40 kgs cyclonol or a similar hydrocarbon and 168 kgs calcined soda of 99% are then mixed therewith in a suitable mixing vessel. The mass which is now altogether homogeneous, is treated with 50 kgs water and may then further be shaped at once, as indicated with regard to Examples 1 and 2.

There are obtained in this manner either beautiful, glossy stable refined pieces or threads, flakes and the like which already at 25–30°C dissolve clearly in water and exhibit a very good foaming power and contain 69.0% fatty acid plus hydrocarbons.

Example 4

400 kgs distilled fatty acid of the composition given in Example 2 are mixed at 30–35°C with 168 kgs calcined soda of 99% and are saponified under addition of 50 kgs water and a suitable perfume which takes 1–2 minutes. The mass is then mixed in a kneading machine with 600 kgs dry base soap with the addition of 22 kgs of a tylose paste of 10% whereafter 40–50 kgs disodium phosphate which has been dried by centrifuging and melted in its own water of crystallization are added. The well mixed mass is then banded and can be directly pressed to form beautiful bars or glossy pieces or can also be shaped into fine threads or rolled into flakes or the like. The products have a glossy surface, are stable in contact with the air, wash and foam well and have a fatty acid content varying between 69 and 70%.

Example 5

400 kgs distilled palm oil fatty acid as indicated in Examples 1 and 2 are well mixed at 32–35°C with 220 kgs ground potash of 96–98% whereafter 10–20 kgs water are added. The saponification is complete within a minute and the soap obtained is at once banded and after a short storage can be well and easily pressed into the form of threads or bands or flakes.

The products are short and not hygroscopic and quickly and readily dissolve in water. The turbidity point is about 42°C.

Various changes may be made in the details disclosed in the foregoing specification without departing from the invention or sacrificing the advantages thereof.

ADOLF WELTER.

Published May 25, 1943

Serial No. 120,900

ALIEN PROPERTY CUSTODIAN

AMPLIFIER WITH SECONDARY ELECTRONIC EMISSION

Pierre Chevallier, Paris, France; vested in the Alien Property Custodian

Application filed January 16, 1937

It is known to use the emission of secondary electrons by auxiliary electrodes with the object of amplifying a flux of primary electrons in a predetermined ratio. The subject of the present invention is an amplifying tube based on this principle and characterised essentially by the use of successive grids or diaphragms brought to suitably chosen potentials, and focussing the secondary electrons emitted towards a receiving electrode, an image of the emitting electrode being thus formed on said receiving electrode.

These grids or diaphragms are disposed between the cathode and the anode of the tube perpendicularly to the electric field which is set up in the tube when a potential difference is applied between the said cathode and anode. By reason of this arrangement of the auxiliary electrodes, it is possible to use one of these auxiliary electrodes for acting on the beam of electrons, either to interrupt it periodically or to modulate it to a given frequency, or, generally speaking, to produce any desired fluctuation in the intensity of this beam and of the current supplied by the tube.

Such as to increase the amplifying ratio of the tube, it is possible to constitute said tube with several groups of electrodes connected in series, each group comprising a secondary electronic emissive electrode, one or several focussing electrodes, and a receiving electrode. Two successive groups may have one or more electrodes in common. For instance, the receiving electrode of the first group is the emitting electrode of the second group, or the first focussing electrode of the first group is the emitting electrode of the second group.

The invention also covers devices in which use is made of these particular amplifying tubes, and which will hereinafter be described, as well as the said tubes, with reference to the accompanying drawings, in which:

Figures 1, 2 and 3 shows types of amplifying tubes according to the invention, and

Figure 4 shows a device for the utilisation of another type of such a tube.

According to Figures 1, 2 and 3, the amplifying tube comprises a casing 1 in which are enclosed a cathode 2, an anode 3 and a plurality of auxiliary electrodes 4, 5 and 6. The cathode 2 is emissive of primary electrons. It is either constituted or covered by a photosensitive substance, and emits electrons when receiving a luminous flux 7^a, or is heated to emit electrons by thermo-electronic effect. Any other device producing electrons may be utilised. In the case of Figure 1, the cathode 2 is photosensitive and disposed perpendicularly with reference to the axis of the tube. It may also be inclined on the axis of the tube (Figure 4), or have an incurved form (Figure 3). The cathode of the tube in the Figure 4 is intended to be excited either by reflection of the luminous flux 7^b or by transparency by the luminous flux 7^a. The tube in the Fig. 2 is provided with a thermo-electronic cathode.

The casing 1 has any form, but it is preferable to give it an elongated form, in order to dispose the cathode and the anode at each of the extremities, and the auxiliary electrodes in the centre part between the cathode and the anode.

The auxiliary electrodes 4, 5 and 6 are constituted by grids or by diaphragms. The grids are formed either of plates having holes bored therein, or by wires stretched between supports, or in accordance with any arrangement adopted, for examples in the grids of radioelectric tubes, and composing meshes of any dimension.

A modification of the invention concerns a tube in which both grids and diaphragms are arranged in any order.

In the tube of the Fig. 1, the electrode 4 is constituted or covered by any known photo sensitive substance or substance of high secondary electronic emissivity. The electric field in the tube drives the primary electrons emitted by the cathode 2 towards the electrode 4. The shock of each primary electron on the electrode 4 generates several secondary electrons which are emitted in all the directions. The secondary electrons are driven and made to converge towards the receiving electrode 6, which may be the anode, by means of the electric fields created by the focussing electrodes 5^a, 5^b. These focussing electrodes are in any number. A good result is obtained with two of such electrodes.

The tube in the Fig. 2 is provided with two amplifying groups of electrodes. The first group comprises the emitting electrode 4^a, two focussing electrodes 4^b, 5^a and the receiving electrode 6^a. The second group comprises the emitting electrode 4^b, two focussing electrodes 5^a, 6^a, and the receiving electrode 6^b. Any number of groups of electrodes may be disposed in this manner, in series and overlapping each other. Secondary electrons are emitted by the electrode 4^b under the shock of the secondary electrons emitted by the electrode 4^a.

In the tube of the Fig. 3, the successive groups of electrodes have only one electrode in common. The electrode 4^b is the receiving electrode of the first group and the emitting electrode of the following group.

In order to be able to control the beam of electrons, it is possible to apply to the electrodes having no secondary radiation, potentials which may or may not be periodical. By reason of these electrodes, it is possible to interrupt or modulate the current supplied by the tube. It is also possible by these means to introduce into the current signals such as the synchronising signals in a long-distance transmission device. For this introduction of signals, it is obviously necessary for the signals to be set up at moments when the electronic flux, and consequently the incident luminous flux, with a photo sensitive cathode, is not zero.

These control electrodes having no secondary radiation may be separated from the system by screen grids as is frequently the case, for example, in radio-electric tubes.

Figure 4 illustrates a teletransmitting apparatus using a tube according to the invention. This apparatus comprises a device **8** for analysing objects or images to be transmitted. The analysing device **8** sends a luminous flux **7**^{b} on to the cathode **2** of the tube **1**. The suitable tensions are applied to the various electrodes of the tube **1** by electric source **9**. The latter may be entirely or partially replaced by a single source and a potentiometer (not shown) from which are taken the required tensions, or may be connected in series.

A resistance **10**^{a} is inserted in the circuit of the receiving electrode **6** of the tube, and the variations of tension at the extremities of the resistance **10**^{a} are amplified by the device **11**^{a}. Use may be made of the current traversing the anode circuit of the tube, with the aid of the resistance **10**^{b}, and the variations of tension to the terminals of the resistance **10**^{b} may be amplified by the device **11**^{b}. The current provided by the amplifiers are then transmitted. If the tube has several receiving electrodes, as in Fig. 2, the currents in the receiving electrode circuits are amplified and transmitted in the same manner.

According to Fig. 4, the synchronising signals produced by the device **8** are applied by the connection **12** to one of the focussing electrodes having no secondary radiation **5**^{a}. Moreover, a source of alternating electromotive force **13** is inserted in the circuit of another focussing electrode **5**^{b} in order to modulate the current fed by the tube. The source **13** may also be constituted by a source producing current impulses or by a switch permitting of interrupting regularly or at will the current supplied by the tube.

It is obvious that the circuits of Figure 4 could be modified so as to apply both synchronising and modulating signals to the same electrode.

Finally, means **14**^{a}, **14**^{b} fed by a source **15**, produce a longitudinal magnetic field inside the tube in order to concentrate the electrons emitted by the cathode and by the auxiliary electrodes. These means are not essential, but they permit of obtaining more concentrated beams of electrons.

By reason of the effect of these electric and magnetic fields, and if the tensions applied to the auxiliary electrodes, grids or diaphragms, are suitably chosen, the functioning of the tube is as follows. The electrons emitted by the cathode **2** are accelerated by the electric field and accessorily concentrated by the magnetic field. These electrons encounter the auxiliary electrode **4**, and secondary electrons are emitted in all directions. They are directed by the field existing beyond **4** in the direction of the positive potentials, that is to say, towards **5**^{a}. According to the potential of **5**^{a}, the secondary electrons of **4** will form in the enclosure an image of the cathode, or they will impinge on **5**^{b}. It is the latter alternative which is adopted, and it will be seen that the auxiliary electrodes become virtual cathodes, the emission of which increases in intensity as their order increases. The auxiliary electrodes such as **4**^{b} in the Fig. 2 are brought to sufficiently high potentials in order that the electrons may in turn produce therein a secondary emission, thus increasing the efficacy of the system in considerable proportions. The phenomena set up is similar to that known in discharges in gases under the name of "ionisation by impact." It will be seen that if each impact liberates a number p of secondary electrons, the amplification of the initial flux at the end of n stages is p^n.

PIERRE CHEVALLIER.

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BY A. P. C. | Filed Jan. 16, 1937

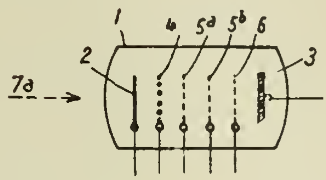

Fig. 1

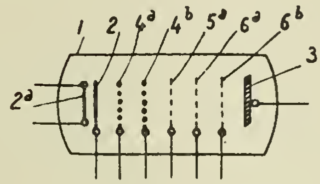

Fig. 2

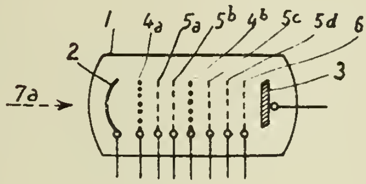

Fig. 3

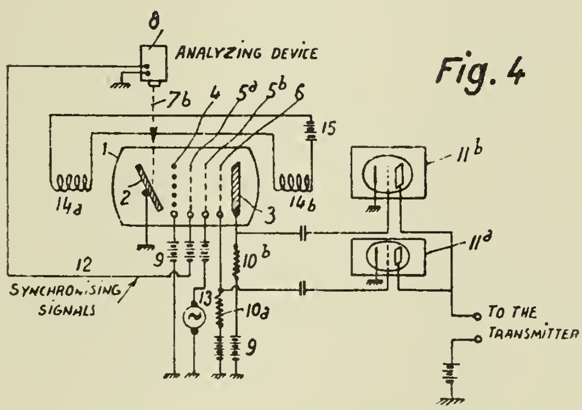

Fig. 4

Pierre Chevallier
INVENTOR
By Otto Munk
his ATT'Y

Published May 25, 1943 Serial No. 134,265

ALIEN PROPERTY CUSTODIAN

MOTOR CAR BODIES

Freiherr Reinhard Koenig-Fachsenfeld, Stuttgart-N, Germany; vested in the Alien Property Custodian

Application filed April 1, 1937

My invention relates to the bodies of motor cars and more especially to streamlined car bodies.

It is an object of my invention to provide a car body which creates a minimum of air resistance without the turning capacity of the car being impaired.

It is another object of my invention to provide a streamlined car body offering a larger space for the accommodation of passengers and luggage than similar bodies hitherto designed.

In the manufacture of modern motor cars the bodies have been shaped as a rule for the least possible air resistance by forming them with a taper ending, at the rear end, either in a point or in an inclined or vertical edge.

Quite especially in cars having several seats arranged side by side the width is large in proportion to the length, the ratio of length to width being for instance 2.5 or 3:1, the maximum width and height, i. e. the maximum cross section, being situated about in the middle between the two wheel axles. The overall length is limited in consideration of driving properties and space. In addition thereto the car body must not project unduly beyond the rear axle. The width of the body may for instance be 1.40 metres, the height 1.20 metres at the place of maximum cross section, the body extending for instance 1.70 metres to the rear from this point.

In view of the admissible length of the car a body answering the requirements of correct air flow cannot be made to taper, from the point of maximum cross section to a pointed end or to a horizontal or a vertical edge, so that it is not possible to obtain a sufficiently lean shape. In spite of these facts many attempts were made to obtain a kind of streamline shape of agreeable appearance by a sudden tapering of the car body which however involved considerable drawbacks, since the sudden narrowing down of the passenger space as to width and height is very inconvenient and no sufficient space is left for luggage etc. It is mainly due to these circumstances that hitherto the streamlined car has not come into wider use, the less so, since these drawbacks are not accompanied by any reduction of air resistance worth speaking of. The last mentioned type with its fictitious streamline appearance obtained by a sudden narrowing down of the car body, does not pay due regard to the real air flow alongside of the car body. For this air flow does not by any means cling to the outer surface of the rear part of the body but detaches itself from the body already near the maximum cross section and gives rise to eddies, at the same time forming a large dead air area. The final detaching and eddying is still furthered by obstacles hindering the air flow, such as the depressions surrounding the windows or the projections formed on the car body in the critical area of detachment. If it were intended to keep the air flow in continuous contact with a rear part ending in a point or edge, i. e. if a sufficiently lean streamline body shall be obtained the rear part of the car would have to be made unduly long, extending for instance several metres beyond the rear axle in a passenger car. Obviously this is impossible in a car for general use which must be short in order to possess a high turning capacity.

According to the present invention now that part of the rear part of a streamlined car body, which exceeds the utilizable and therefore practically admissible length, is cut off and a flat rear face is formed, the car body gradually tapering in a streamline shape of sufficient leanness to permit the air flow to cling to the rear part of the body without abruptly breaking off. This streamline does however not end in a point or an edge but is cut off at the point where it would exceed the length available in view of the driving properties of the car. In dependency on the desired length of the car the body is cut off at a point of larger or smaller cross section. In a longer car body the end surface thus formed will be smaller than in a car of smaller length. I thus retain the theoretically most favorable streamline shape as far as this is practically possible. The length of the streamlined portion of the car body may vary according to the requirements of the individual types of cars. The section which determines the flat end surface, may extend perpendicularly or obliquely to the longitudinal axis of the car and the rear face thus formed may also be arched or rounded off. The term "flat face" used in this specification should be construed in this broad sense.

While in the known streamlined cars the air flow already detaches itself from the body near the maximum cross section, it remains in contact with the body surface of a car body according to this invention until reaching the flat rear face, so that the entire length of the car is utilized for the guiding of the air flow, which thus detaches itself at a point of considerably smaller cross section than in the known cars. This involves a considerable advantage since the cross section at which the air flow is detached, determines the unavoidable air resistance. Thus a car body according to this invention possesses a very much lower air resistance than the car bodies hitherto known.

Even with the same length the new car body provides a considerably larger inside space which may completely be utilized for storing luggage and the like. In this respect a car body formed in accordance with my invention is greatly su-

perior to the body shapes hitherto used. If it is temporarily admissible to increase the length of the car, a luggage grid may be provided at the flat rear end. The air resistance of the car is not increased thereby provided that the luggage is arranged within the dead area. It is also possible to form a depression in the flat rear end face and to shelter spare wheels, luggage etc. in this depression.

I am further enabled to force the air flow to break off at the flat end face quickly and clearly, i. e. in a predetermined point. This is of particular importance in connection with arched, i. e. rounded or with obliquely extended end faces, in which cases I prefer to form a breaking edge at or in front of the flat end face. I may for instance take in or set off the car body so that an edge is formed which forces the air stream to break off.

In another embodiment of my invention the outer surface of the car body, instead of forming a breaking edge, may extend further to the rear without interruptions and without considering the flat end face, a guide surface being arranged at the point where the outer surface of the car body turns into the flat surface, this guide surface forming the continuation of the outer shell of the car and guiding the air flow so as to break off only at the end of this surface, i. e. at a well defined point. This guide surface, which forms a kind of cuff at the end of the car body, may be made of any desired material, for instance of transparent material in order to attract less attention.

By thus shaping the rear part of the car body and the breaking edge, I attain that the air flow retains to a certain degree the direction once imparted to it even after having been detached from the car body, i. e. even after the air flow has lost the guidance hitherto offered by the car body. I am thus enabled to guide the flow to a certain extent even after it has left the car body.

Passenger cars are already known in which the body consists of a main part and of an additional part, arranged above said main part, which is narrower than the main part and is frequently streamlined, ending in a point or an edge. Such cars may also be shaped in accordance with my invention and in this case the lower main part of the body ends in a horizontal edge while the narrower top part ends in a flat end surface. It is also possible to arrange the two parts in such manner that the main part as well as the additional part end, together in a flat end surface. Accessories such as mud-guards which are provided for practical reasons may also be shaped in the same sense as the car body formed in accordance with my invention.

It is important that the car body gradually taper from the place of the maximum cross section (which is predetermined by practical reasons) to the flat end face only to such a degree that the air flow clings closely to the entire rear part, being thus guided and breaking off only near the flat end face, whereby the total available length of the car can be fully utilized for the reduction of the air resistance.

In the drawings affixed to this specification and forming part thereof several embodiments of my invention are illustrated diagrammatically by way of example.

In the drawings

Fig. 1 is a diagrammatic side elevation of a so-called semi-streamlined car body, while

Fig. 2 is a similar view of a car body the rear part of which is unduly shortened.

Fig. 3 is a similar view showing a car body according to my invention, while

Fig. 4 is a more detailed view of another embodiment showing a depressed end face utilized for the accommodation of spare tyres, the rear part of the car being provided with rear mudguards.

Fig. 5 illustrates a third embodiment of my invention, while

Fig. 6 shows an end face formed with a breaking edge.

Referring to the drawings and first to Fig. 1, **1** is the so-called semi-streamlined body, while **2** are the wheels. This body is very slender in order to favorably reduce the air resistance near the bottom. The body is however too long for a motor car.

The car body shown in Fig. 2 is much shortened so that an incompletely streamlined body results. From the point from which the streamline should properly form a continuation of the front part **1** of the car body in order to form the theoretically correct shape (indicated at **3** by dash lines) the car body is suddenly shortened, ending in an edge. The airflow can therefore no longer follow the form of the stern but detaches itself already near the point of the maximum cross section. There result a strong eddying and a large dead air area and poor aerodynamic conditions.

The example illustrated in Fig. 3 shows, in comparison with Figs. 1 and 2, the gist of the invention. **4** is the front part of the car body. **5** designates the driver's seat, and from this point on the car body assumes a slender streamline shape **6**. From this lean form which is theoretically favorable, the rear part **7**, indicated in dash lines, is cut off at the point indicated by the arrow **8**. Thus the body is cut off where it would exceed the utilizable length and it here forms the flat end face **9**.

In Fig. 4 **9'** is the flat end face in front of which a space is provided for the accommodation of spare wheels **10** and the like, while **11** is a rear mud-guard. The mud-guards are streamlined as far as possible, that part which would exceed the practically utilizable length, being cut off and a flat end face **12** being formed.

In Fig. 5 **13** is the car body which is shaped in an aerodynamically favorable manner, but is cut off where it would exceed the practically utilizable length, ending in a flat end face **14**. In order to force the air flow to break off at the flat end face, the shell of the car body may be extended, wholly or partly, beyond this end face so that a kind of guiding surface **15** is formed which causes the air flow to break off suddenly at the rear end of the guiding surface.

For the same purpose a breaking edge **17** is formed by the body near the flat end face **9''** (Fig. 6), this edge **17** improving the air flow conditions in that the flow breaks off at a well defined place instead of gradually breaking off over a more extended surface of the shell of the car body. This feature improves quite particularly the effect if rounded end faces are used.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

FREIHERR REINHARD KOENIG-FACHSENFELD.

PUBLISHED
MAY 25, 1943.
BY A. P. C.

F. R. KOENIG-FACHSENFELD
MOTOR CAR BODIES
Filed April 1, 1937

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134,265
2 Sheets–Sheet 1

Fig. 1.

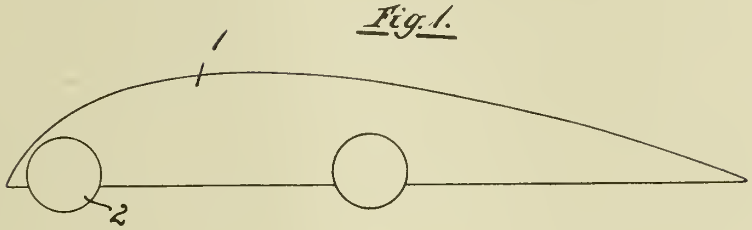


Fig. 2.

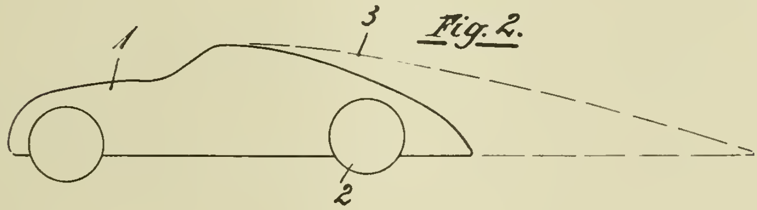


Fig. 3.

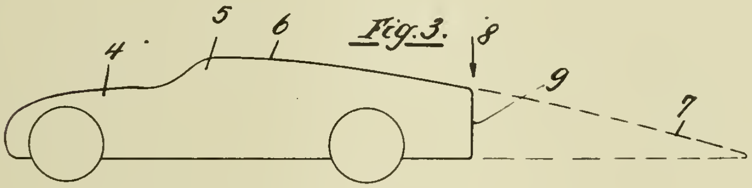
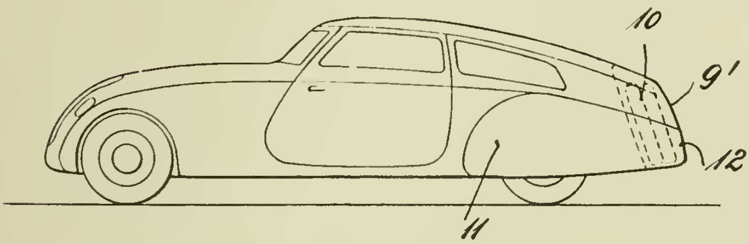


Fig. 4.



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by Michaelis & Michaelis

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Fig. 5.

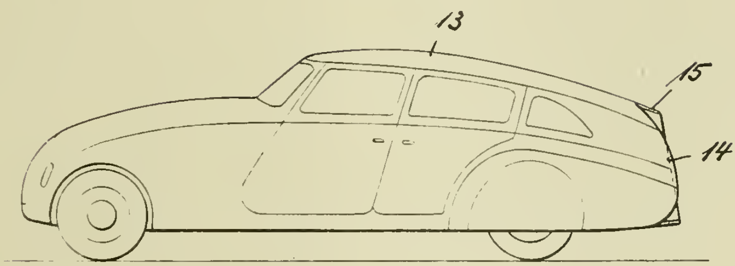
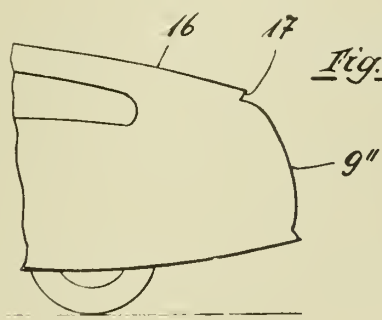


Fig. 6.



Jnventor

Published May 25, 1943 Serial No. 135,324

ALIEN PROPERTY CUSTODIAN

REGISTER MOVED BY THE PAPER CARRIAGE

Hugo Kämmel, Thuringia, Germany; vested in the Alien Property Custodian

Application filed April 6, 1937

The invention relates to a register moved by the paper carriage with a device for controlling the working condition of other registers for calculating machines or the like.

At these registers the arrangement of more than two controlling members made large difficulties. Consequently such registers were not made hitherto.

According to the present invention these disadvantages are avoided by rockable arrangement of the controlling members upon a common shaft, whereby the controlling members are provided with handles projecting out through the wall. Advantageously controlling members for adjusting of the working condition (total-taking, normal position, sub-total-taking) are arranged on the front wall of the register as well as controlling members for adjusting the kind of calculation.

Figure 1 shows a cross-sectional elevation of a column totalizer provided with a reversing gear, the section being taken on the line, I—I on Figure 2.

Figure 2 is a sectional elevation of the members for attaching the totalizer.

In carrying the invention into effect, according to one form and as applied by way of example to a column totalizer for a calculating machine, to the two limbs or arms, **1** and **2**, Figures 1 and 2 of the U-shaped front wall **3** of the register, the two side walls **4** and **5**, are secured by means of the screws, **6**, Figure 2. The two side walls, **4** and **5**, are also disposed on the limbs **7***a* of the U-shaped brace **7** (in Figure 1 only the right hand limb **7***a* is visible by means of the screws **8**. The limbs **7***a* of the brace **7** are bent outwards at their free ends at right angles, and the parts, **9**, so bent over, engage in slots **9***a* formed in the side walls **4** and **5**. The brace **7**, is thus prevented from making any undesirable rotational movements about the screws, **8**, by the tension of the springs, **10**, which are attached to the holes, **11**, of the brace and the result of which movements would be to prevent the springs, **10**, acting with sufficient force upon parts which will be described hereinafter. The cover plate, **12**, of the register which is of the shape shown in Figure 1, has its front portion, **13**, bent over downwards at a right angle. The portion, **13**, is disposed in the cut away portion, **14**, of the front wall, **3**, so that the outer face of this portion of the cover plate, **12**, lies flush with the front wall. The cover plate, **12**, is fastened to the front wall by means of the screws, **15**, Figure 1. Furthermore, the cover plate, **12**, is fastened by means of the screws, **16**, Figures 1, 2 to the brace, **17**, which in its turn is secured by means of the screws, **18**, (in Figure 1, only the right-hand screw is shown), to the side walls, **4** and **5**, of the register. The cover plate, **12**, is also secured to the part, **20**, by means of the screws, **19**. The ends, **21** and **22**, Figure 1, of the part, **20**, are of dove-tail formation and fit with these dove-tail parts into correspondingly shaped holes in the side walls, **4** and **5**, of the register. In the part, **23**, of the cover plate, **12**, which is of curved form and faces towards the front, a window, **24**, is arranged through which the result of the calculation may be read.

In the front portion of the register, there is provided, as shown in Figure 1, an intermediate wall, **25**, which is secured to the side walls, **4** and **5**, by means of the screws, **26**. The bolt, **27**, which extends into the intermediate wall, **25**, is reduced at its end, **28**, and provided with a screw thread, while at its other end, **29**, the screw head is formed. The end, **28**, of the bolt, **27**, is screwed into a hole, **30**, which is formed in the intermediate wall, **25**, and has a corresponding screw thread to that formed on the end, **28**, of the bolt, **27**. On the bolt, **27**, the control levers, **31**, are mounted so as to be capable of oscillation thereon, the control levers serving to set other registers for operation. The control levers, **31**, have notches, **32**, with which engage the noses, **33**, of the pawls, **35**, one of which is provided for each control lever. The pawls, **35**, are arranged so that they can pivot around the axle, **34**, and the control levers, **31**, are capable of being held by the pawls in each of three different positions, Figure 2. The pawls, **35**, are acted upon by the torsion spring, **36**, so that they always engage with one of the notches, **32**. The control levers, **31** are adapted to be adjusted by hand, by means of the grip-shaped parts, **37**, Figures 1 and 2, the faces, **31***a*, of the control levers acting upon the noses, **31***b*, of the two-armed levers **31***d*, which are arranged so that they can pivot around the axle, **31***c*, Figures 1 and 2. To the arms, **31***e*, of the levers, **31***d*, are linked at the points, **31***f*, the levers for controlling the operation of other registers, such as, for example, an addition device, which do not form a part of the present invention and are therefore not shown in the drawings.

The control levers shown in Figures 1 and 2, are intended for two grand total registers or cross footers, the control levers, **31***u*, and **31***v*, serving for the control of one of these registers and the control levers, **31***x* and **31***y*, for the control of the other grand total registers or cross footers. By means of the control levers, **31***y* and

31v, each of the two grand total registers or cross footers are set for addition, subtraction or in a neutral position, and by means of the control levers, 31x and 31u, are set for total taking, sub total taking or in a neutral position.

Figure 2, shows the different positions of the control levers. The dotted line position in this figure shows the position of the control levers, 31y and 31v, for addition, "A", the continuous line position for neutral "N", and the chain line position for subtraction "S", while for the control levers, 31x and 31u, the dotted line position indicates the neutral position (N), the continuous line the total taking position (T) and the chain line the subtotal taking position (ST).

In order to protect the control levers, 31, against unintentional displacement, and to maintain them in the position into which they have been set, the following arrangement has been provided. An axle, 38, Figure 2, which is rotatably mounted at one end in the intermediate wall, 25, and at the other end, in the front wall, 3, is flattened on the surface which normally faces the pawls, 35, so that each of these pawls may be freely disengaged by swinging in an anti-clockwise direction, if the corresponding control lever, 31, is swung out of position. On the axle, 38, a knob, 40, is rigidly secured by the screw, 39, by means of which knob, the axle, 38, may be rotated through an angle of slightly greater than 90 degrees. On the neck, 41, of the knob, 40, is arranged a device, 40a, which indicates the normal and operative positions of the axle 38, and is capable of being retained in either of these positions. The indicating device, 40a, is formed of spring steel and has at its end, 42, Figure 1, a projection 43, which is adapted to snap into corresponding depressions, 44 and thus holds the axle, 38, in the position in which it has been set.

If it is desired to prevent the control levers from being unintentionally swung out of one of the three positions, the axle, 38, is rotated by means of the knob, 40, through an angle slightly greater than 90 degrees, in a clockwise direction until the projection, 43, of the indicating device, 40a, snaps into the depression, 44a, on the front wall, 3. The above movement causes the surface, 45, of the axle, 38, to contact with the face, 46 of the pawl, 35, and thus prevents the nose 33, of the pawl from being disengaged from one of the notches, 32, of the control lever, 31, and the latter is thereby prevented from being displaced from the position into which it has been set.

HUGO KÄMMEL.

PUBLISHED

MAY 25, 1943.

BY A. P. C.

H. KÄMMEL

REGISTER MOVED BY THE PAPER CARRIAGE

Original Filed Aug. 5, 1931

Serial No.
135,324

Fig. 1

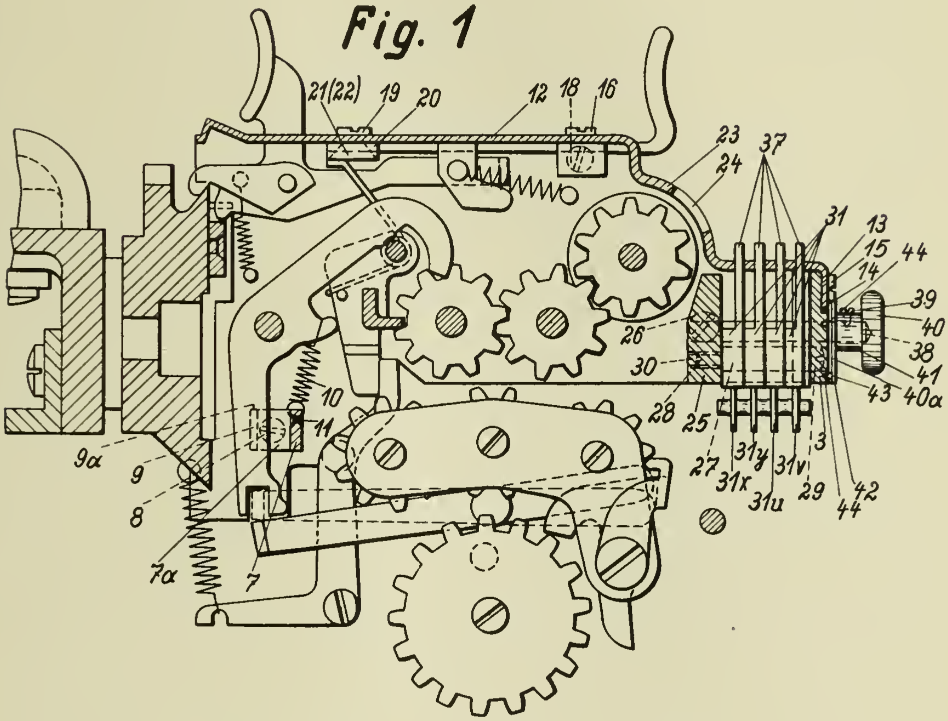
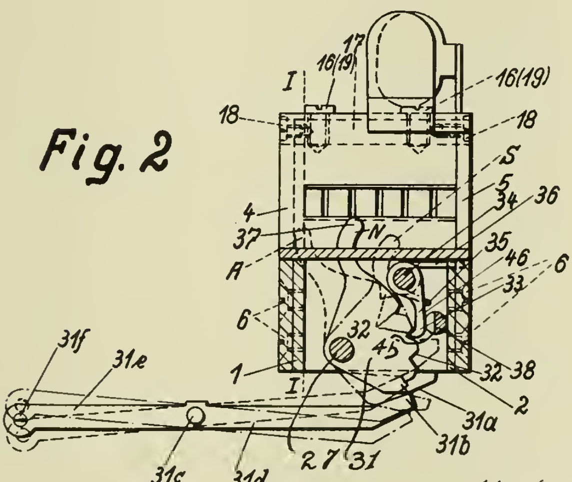


Fig. 2



H. Kämmel
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By Glascock Downing & Seebold
Attys.

Published May 25, 1943 Serial No. 136,429

ALIEN PROPERTY CUSTODIAN

TAKING-OFF DEVICES FOR SUCTION FILTERS

Gustav Netzel, Dresden, Germany; vested in the Alien Property Custodian

Application filed April 12, 1937

This invention relates to a device for taking off the filter cake from a couch roller cooperating with a suction filter.

In paper making, the filter cake formed on a suction filter is taken off by a couch roller which is either plain or provided with elevations and from which the cake is removed by means of strippers, scrapers, etc. This method is open to the objection that a portion of the cake collects on the back of the scraper and is finally taken off from the couch roller in larger lumps. If the scraper is, moreover, applied closely to the couch roller usually consisting of rubber or some other elastic material, damages may occur which interfere with proper taking off. This risk is particularly great if a couch roller is employed which is fitted with elevations and depressions.

The invention completely eliminates the defects mentioned by employing an auxiliary roller cooperating with the couch roller for removing the filter cake therefrom. The auxiliary roller preferably has a much smaller diameter than the couch roller and is either stationary, or rotates intermittently, or revolves at considerably greater circumferential speed than the couch roller in the same or opposite direction. The auxiliary roller may be provided with special driving means and variably adjustable relative to the couch roller.

Like the couch roller, the auxiliary roller may have elevations and depressions in the manner of a fluted roller. It may consist of several parts, constructed as plain or hollow shaft, or taper towards its ends. It is particularly advantageous to form the couch or auxiliary roller from elastic material or to provide a coating therefor from such material.

By way of example, the invention is illustrated in the accompanying drawing, in which

Figure 1 is a section of a device according to the invention, the parts being shown in diagram;

Fig. 2 is a top view of the auxiliary roller cooperating with the couch roller according to Fig. 1;

Figs. 3 to 7 show other forms of the auxiliary roller;

Fig. 8 is a view of the drive and arrangement of the auxiliary roller; and

Fig. 9 is a view of the drive on the line VIII—VIII, of Fig. 8.

Referring to the drawing:

The filter drum **1** rotates in the direction of the arrow in the trough **2** and collects on its circumference the filter cake **3**. Before the drum **1** carries out a second revolution in the trough **2** the filter cake **3** is taken off by a couch roller **4** having an elastic cover **5** and rotating in a direction opposite to that of the drum **1**. The cover may consist of rubber, rubber-like horsehair, sponge rubber, soft felt, etc. The couch or taking-off roller **4** may be plain, fluted, etc. and rotates at the same circumferential speed as the filter drum **1**.

Removal of the filter cake **3** from the couch roller **4** is effected by the auxiliary roller **6** disposed on the shaft **7** in a member **8** movably disposed on a shaft **9**, whereby it becomes possible to vary the distance between the auxiliary roller **6** and the couch roller **4**. The auxiliary roller **6** is driven by means of the toothed wheels **10**, **11**, **12**, the wheel **10** being adapted to be engaged and disengaged by a clutch **13**, **14**. The clutch member **14** is longitudinally displaceably arranged on the shaft **15** and can be manually or automatically controlled by the rods **16**, **17**. The drive for the couch roller **4** and the filter drum **1** is not shown, as it is of no importance for the invention.

The auxiliary roller **6** for taking off the filter cake from the couch roller **4** may either stand still, rotate more slowly or quickly than the couch roller or carry out intermittent motions. Speed and direction of rotation of the auxiliary roller **6** are regulated by exchanging the wheels **10**, **11**, **12**. The roller **6** is stopped by disengaging the clutch **13**, **14**, and intermittent drive of the roller is brought about by a corresponding engaging and disengaging operation of the clutch, for which purpose the rod **17** of the clutch can be connected with a gear box **18**.

In the construction shown in Fig. 1 the auxiliary roller **6** is a smooth cylindrical shaft. Fig. 3 shows a fluted auxiliary roller **6***a*, and in the embodiment according to Fig. 4 the auxiliary roller **6***b* is formed of the members **6***b*′, **6***b*″, **6***b*‴, etc. which may differ in diameter, be offset, etc.

The construction according to Fig. 5 employs an auxiliary roller **6***c* weakening towards the ends, whilst the auxiliary roller **6***d* according to Fig. 6 increases in thickness towards the ends and has a reduced diameter in its center.

As indicated in Fig. 7, the auxiliary roller **6***e* may be constructed as hollow shaft, possibly connected with a piping supplying a heating medium, or, as shown in Fig. 9, it is provided with an elastic cover **19**. It is further possible to construct the auxiliary roller entirely from elastic material.

GUSTAV NETZEL.

PUBLISHED

MAY 25, 1943.

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TAKING-OFF DEVICES FOR SUCTION FILTERS

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2 Sheets-Sheet 1

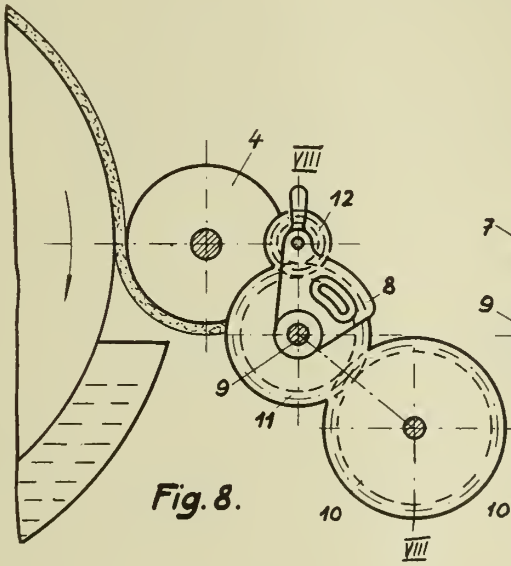

Fig. 8.

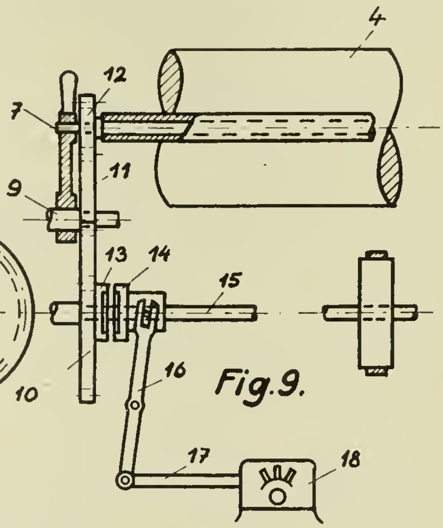

Fig. 9.

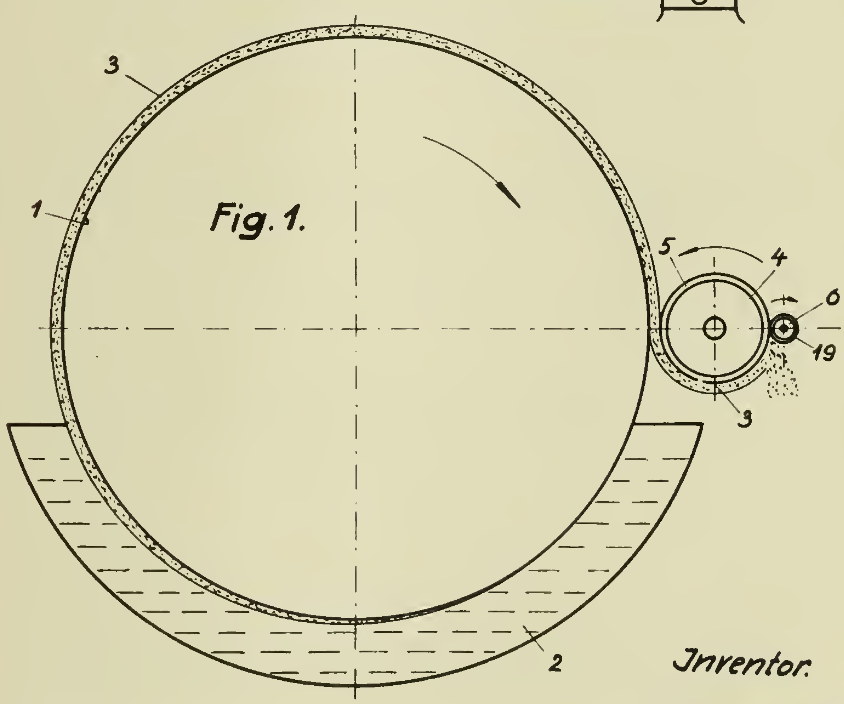

Fig. 1.

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MAY 25, 1943.	TAKING-OFF DEVICES FOR SUCTION FILTERS	136,429
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Fig. 2

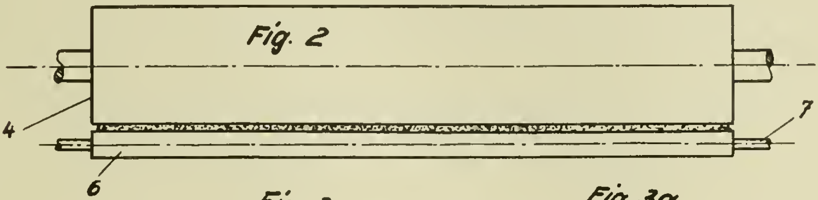


Fig. 3

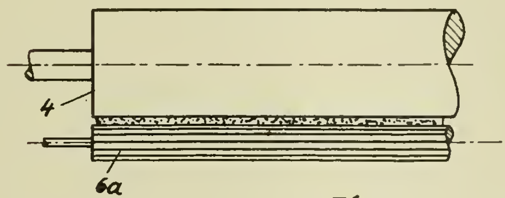


Fig. 3a

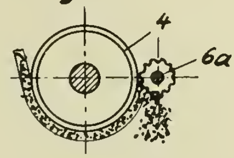


Fig. 4

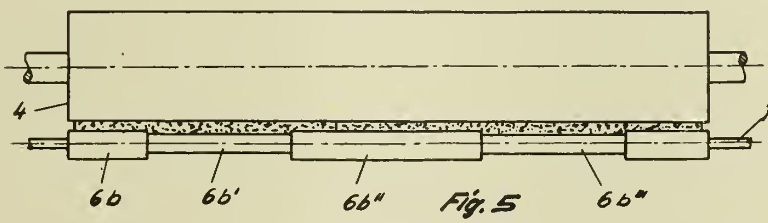


Fig. 5

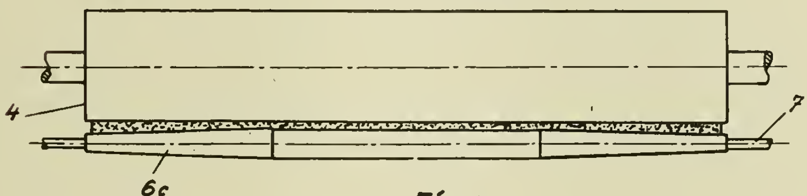


Fig. 6

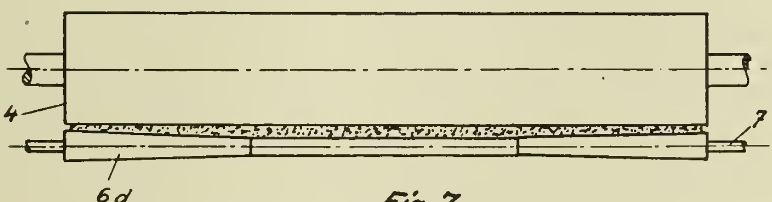
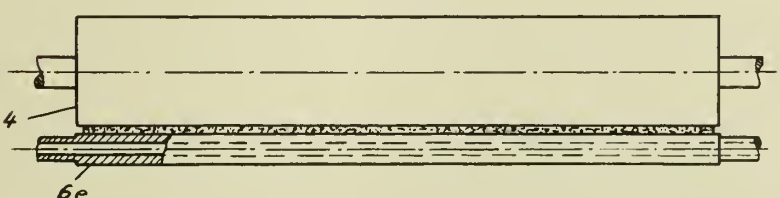


Fig. 7



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Published May 25, 1943 Serial No. 146,302

ALIEN PROPERTY CUSTODIAN

ADDING MACHINE

Kurt Somieski, Hamburg, and Emil Dietzel, Harburg, WI, Germany; vested in the Alien Property Custodian

Application filed June 3, 1937

Mechanical calculators are known in the most various makes. There are machines with the key mechanism acting on a case with small blocks, this block case acting again on the proper counting mechanism, so that the addition takes place and can be made visible at any time. However, these machines offer so far still the difficulties of all complicated machines, viz. they are easily subject to sources of errors; on the other hand their manufacture is very expensive, so that there is a tendency to simplify the machines. The present invention serves to realize such aim, because the whole of organs are so arranged that they lie organically closely side by side, to avoid unnecessary lengths of levers, and furthermore to obtain the shortest ways and plainest devices for the effect wanted.

The principal idea of the invention therefore consists firstly in the arrangement of the devices already known in principle, in their relations to one another, in such a manner that between the so-called key basket and the proper counting mechanism is placed the stop box, while the carriage guide on the back of the machine joins immediately the counting mechanism. By doing so the shortest ways will be obtained, and the plainest connections for the actions of the various parts on one another, which will form still important singular characteristics of the invention, resulting, however, in their singular parts immediately by the compilation and pressing together of these single parts arranged locally as belonging together, but not resulting positively without character of invention, being combined merely in the sense of unity.

As to the key basket, there have been hitherto always difficulties of uniting the different keys in their arrangement, every time varying, so that the strokes corresponding to the operation of the block box of each key could be arranged vertically one over another, which is necessary for technical reasons. One has proposed for this purpose difficult rods of levers and such the like, without meeting with the plainest solution of the problem. This is effected, according to the invention, in the simplest manner, by arranging between the block box following immediately the key basket, as per invention, and the key levers continued to their fulcrums, a blind-like flap-device extending over the whole width of the key basket, containing as many flaps, as the number of single keys to be operated. Then it will be relatively simple, to construct a connection from each key to the flap, necessary for the operation of the blind flaps, because it does not matter for the operation of the flap in what place the lever engages. The blind flaps, are placed, as usual, conveniently rotating on their centre points. This arrangement affords the possibility of disposing the movement of the blind flaps, because they extend over the entire width of the key basket, for the operation of the block box and of the strokes to transfer on same, in any place of the blind, but the whole of flaps vertically one above another. Thereby you will be able of connecting the key levers to the blind flaps at discretion, the key levers being able to take any position, different in relation to the blind flaps, but that you can choose for the transfer of the movement of the blind flaps, engaging points lying exactly vertically one over another, viz. in a straight line, because the movement of the flap extends equally over the whole width. The movement of any key of the key basket, f. i. of 10 keys by mediation of the blind range on a vertical range of movements, it being possible to use always the shortest lever movements and above everything straight lined movements.

Due to the forward movement of the stop box getting necessary by the attendance on the latter, the operation of a stop device, beside the stroke of the lever, will become necessary, permitting the stop box, by the effect of a spring, to advance by one tooth, a well known movement. In order to secure also here the shortest way for the key levers, but on the other side with a view to get the same good effect of the key lever at any position of the key lever, there are provided, by reason of the key levers, three lever flaps, so that the transmission of the key pressure remains always equal, also for the forward movement of the block box.

Beside this general arrangement another arrangement will become necessary, being essential for the simplification of the total installation, viz. the disposition of the stop box on the main driving shaft, on which it is slidable.

A further characteristic of the invention consists of the simplicity of the inking ribbon transport, described in detail by the drawings attached.

Another characteristic of the invention consists of the finish of the rack guide for the counting mechanism. These racks, varying in length, are guided like two flat ribbons, overlapping partly, lying one above the other, the end of one ribbon embracing the other lying on top, by means of a buckle-like clamp, such as is described more minutely in the drawings. Thereby results the possibility of sliding both parts telescopically one against the other having, due to

their flat formation, a faultless guide, and to their buckles, slide-like, open or closed, and fixed at the end, a most plain sliding stop. The question of guiding these parts is thus resolved in the simplest manner, in special consideration of the smallest space being wanted thereby.

My last characteristic of the invention consists in the fact that for the obtension of the so-called intermediate sums no special keys, no electric switching installation in connection therewith are required, as hitherto was the case, but to print the intermediate sum you need only, after the key stroke, draw once more the movement lever of the total device, doing in a certain sense, a void draw, which will cause the intermediate sum to be printed. The printing of the intermediate sum is recorded in a special simple way and facilitates that, immediately emanating from the lever mechanism, the total sum remains ready for printing at a certain point of time, switching itself in by a second void draw of the lever, viz. without operating the lever, and this in a manner more minutely described in the drawings.

Consequently it results a total device the manner of working depends of the special kind or composition of the principal invention idea, the formation of the single parts in the stated manner being only possible by this construction, specially also still a plain guide of the carriage for the cylinder carrying the roll for the printing paper. The latter is only limited in its guide by a locking flap pressing from below, so that it cannot deviate from its guide neither to the right nor to the left. Pressing, however, the flap downwards from outside, two catches on the flap will equally be pressed down, which oppose themselves to the forward movement of the flap, so that you can now withdraw the whole carriage from the total device without any difficulty.

The invention is represented in detail by the enclosed drawings, Fig. 1 and 2 representing the total device but in its essential parts, for better inspection, while Figs. 3–8 for better understanding represent single parts, same as

Fig. 3 The change-over and safety of the tens

Fig. 4 The mechanics of the "intermediate sum"

Fig. 5–7 The bearings of the inking ribbon roller

Fig. 8 The change-over device for the total sum viz. for the simultaneous release of the entire counting mechanism.

As shown in Fig. 1 and 2, keys 1 operate on lever flaps 3 by means of levers 2. The lever flaps 3 have a fulcrum 4. On the lower side of lever flaps 3 is disposed a pestle 6 near 5, which operates on the stop box 7. For instance there are fitted nine lever flaps in 3 vertical rows of 3. The levers 2 of the nine keys 1 operate each on a lever flap 3, viz. in staggered form. However, the pestles 6, disposed below the lever flaps 2, lie all exactly one above the other, and so opposite of a vertical row of stoppers 8 of the stop box 7. Key 1, with the aid of levers 2 and 6, will so attend the stoppers 8 of the stop box 7, which rests on the main shaft 44.

Simultaneously with the attendence on stop box 7, a flap 11, turning round the centre point 10, will be pressed down with the key levers 9, flap 11 operating then on a further flap 13 turning round the centre point 12, flap 13 having on one side of its centre point a draw spring 14, bearing the releaser 15, which engages in an indented plate 16 of the stop box 7. By pressing down the flaps 11 and 13 by means of the key lever 9, the releaser 15 will be lifted out of the indented plate 16, causing, simultaneously with the operation of the stop box 7 by means of the pestles or tappets 6, an advance of the stop box by one tooth each time.

In the known manner the stop box regulates the proper types 13, which strike with the aid of the automatic hammer 18 against the paper on cylinder 19 with the inking ribbon 20. The cylinder 19 is disposed, with the paper guide 21 and the paper roll 22, on a carriage. The carriage is sliding in the guides 23, being secured by two bolts 24 from lateral dislocation. The bolts 24 are fixed on an elastical flap 25, turning round the centre point 26, and being pressed against the carriage by the spring 27. Turning the handle 28 round its fulcrum 29, the toothed wheel 40 of the inking ribbon cylinders 41 will be operated by means of the rods 30, 31 via the centre point 32, rods 33, 34, stop 35, levers 36, 37 and driver 38 being under spring effect 39, and thereby the inking ribbon is advanced by each printing operation, which can be caused by the handle 28.

The inking ribbon cylinders 41 turn with their shafts 45 and the toothed wheel 40 in bearings 47 and 47*a*. On the side of the toothed wheel the shaft 45 is lengthened, bearing here a pressure spring 46, placed between the frame of the machine and the toothed wheel, holding the toothed wheel with the ribbon cylinder and shaft 45 with the short end of the shaft, in the bearing 47*a*. Pressing the inking ribbon cylinder against the spring pressure 46, one end of the shaft in the bearing 47*a* becomes free, and the whole inking ribbon cylinder can then be easily lifted out of its bearing.

Fig. 3 shows the construction and disposition of the type bearer 17, fixed with clamps 42 to the guide 75. Types 43 are placed revolving in point 49, that they may be stricken against the cylinder by hammers 18 in the known manner. The type bearer is fitted with a long hole each at points 50 and 51, in which, by means of a guide, the rack 52 is gliding. Spring 53 exercises a traction downwards from a projection 54. However, this projection 54 rests on a step 55, fitted to a lever 58 turning round the fulcrum 56. This step has still a further break 57. The turning lever 58 is drawn by a spring 59 at its lengthened arm in the direction of the arrow near the spring. At its upper end lever 58, carried turning at 60, bears a cross lever 61, chamfered at one end, and having at the other end a right-angled notch, resting on the fixed point 62. Spring 63 secures the firm position on the fixed point 62, pulling in the direction of the arrow. Now, the known counting device, resp. the commutation to tens, engages in the rack 52 with wheel 64. At 64 the wheel of a commutation to tens has been drawn. Wheel 64 is carried on shaft 48, and with this shaft the whole of the counting mechanism can be engaged and disengaged gliding in slot 65. This wheel has ten teeth and a catch 66 fitted laterally near the tenth tooth. This catch 66, after one revolution, operates on the lever 61; the same turns round the point 60, whereby the fixed position at 62 will be undone by the rectangular notch in lever 61, the whole lever revolving round its fulcrum 56 by the traction of spring 59. Hereby projection 54 will be liberated from the supporting point 55, and rack 52 with projection 54 will be drawn downwards by spring 53, until projection 54 rests on the second step 57 of the turning lever 58. This motion corresponds to one tooth of the toothed wheel 64, being transmitted to the adjacent rack, viz. always

but from the ones to the tens, from the tens to the hundreds, etc.

The junction of these devices of Fig. 3 to Fig. 1 and 2 will be seen from part **43**, which has also been drawn in Fig. 1. The parts have been outdrawn only on account of clearness, to make clear the different figures and their view.

An absolutely reliable working of the transmission of tens is warranted by the disposition of levers **58**, **61** and points **62** and **54**.

Fig. 4 shows the commutation devices for the "intermediate sum", caused merely by a void operation of lever **28**, without touching a special key. By the void operation of lever **28**, lever **69** will be pressed downwards in the direction of the arrow near **68**, by means of the stop **68**, connected to lever **28** by simple lever mechanism. Thereby the whole stop device **70** of the hooks **71** revolves round the fulcrum **67**. Below point **71** there is still a revolving point; because these hooks are all of them fixed on one shaft, and this shaft is again carried in a frame, which is carried underneath the shaft **71** turning separately, that the whole device may be turned away.

Lever **69** is turning at **72**, fixed to lever **73**, which is again connected, at **74**, to the stop device **70**. By revolving the stop device **70** the switch lever **76** will be changed to the hatched position, and hooks **71** free pins **77** of the type bearer. If now the lever **28** is operated again, the gliding device **78** does not engage pin **79** of the counting mechanism release **80**, because the gliding device **78** by its pin **81** and the commutator plate **76** are guided past the pin **79** of the counting mechanism release. Thereby the counting device remains engaged in the racks **52** and the intermediate sum must appear. If the gliding device is brought into the hatched position by a turn of lever **28**, it cannot now engage pin **82** of the counting mechanism release **80**, because the latter has not turned pin **79** round the fulcrum **83** by push rod **78**. Consequently the counting mechanism rests engaged and ready to account, even after having finished the void draw and the draw for the appearance of the intermediate sum. The stop box **7** keeps lever **69** ever ready for the intermediate sum, by means of its stop **84** above the revolving lever **85**, when lever **69** is in rest position.

Fig. 5 shows a single part, viz. the bearing of the inking ribbon, which is also drawn in Fig. 2, showing in enlarged scale, but now in side view, the bearing plate indicated in top view in Fig. 2.

Fig. 6 is a top view of Fig. 5 and Fig. 7, a cross section as per Fig. 5, as it is also represented in drawing as per prescription. Parts **108**—**110** are therefore the deepenings in part **107**, which are not well cognoscible in the other drawings, especially in Fig. 2.

Figs. 5, 6, and 7 show one side **47** of bearing of the inking ribbon rolls. Side **47*a*** of the bearing of the inking ribbon roll is a round closed hole in the wall of the frame of the counting machine. **107** shows here one part of the frame, **17** the circular opening for receiving nut **109** of the inking ribbon shaft (see Fig. 2). **110** shows the opening for the reception of the shaft of the inking ribbon rolls. Due to the fact that by the pressure of spring **46** nut **109** of the ribbon shaft enters the opening **109** of the bearing, the whole ribbon bearing is secured from raising of the ribbon roll. The latter can therefore be removed only by a lateral pressure against spring **46**, because only so the nut **109** comes out of the bearing.

Fig. 8 shows the total release. By key "total release" the stop lever **86** will be turned in the direction of the arrow, releasing the hook **87** on the lever **83**. The latter will then fly round its fulcrum on shaft **90**, placing itself on lever **92** of the revolving lever **93**, together with a roll **91**. Meantime the mechanism works exactly as for the intermediate sum, viz. the state of the counting mechanism will be printed, because it is still engaged in the racks **52**. But when the lever **28** returns, lever **88** presses on lever **92**, the revolving lever **93** turns round its fulcrum **94**, and this lever, by means of the sliding plane **96** and the roll **95** makes revolve the lever **97** round its fulcrum **98**, whereby the sloping sliding plane **99** approaches the roll **100** at the counting mechanism releasing lever **80**, raising thereupon this roll **100** by means of the sliding plane **99**, displacing thereby the counting mechanism releaser **80** round its fulcrum **83**, and removing so the whole of the counting mechanism **64** from the racks **52**. The counting mechanism **64** jumps now back to its zero position, viz. the stops **66** will come to lie again under the lever **61**. In the meantime slide **101**, (which has also operated the rise of roll **100** by the sliding plane **99**, by means of the turning lever **103** round the fulcrum **102**, this lever **103** operating on a pin **104** at the lever **83**) has lowered so far that the plate **103** presses on the stop **108** of the revolving lever **97**, turning the latter round its fulcrum **98**, whereby roll **100** will be relieved again of the sliding plane **99**, returning everything to its original position.

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EMIL DIETZEL.

PUBLISHED	K. SOMIESKI ET AL	Serial No.
MAY 25, 1943.	ADDING MACHINE	146,302
BY A. P. C.	Filed June 3, 1937	2 Sheets-Sheet 1

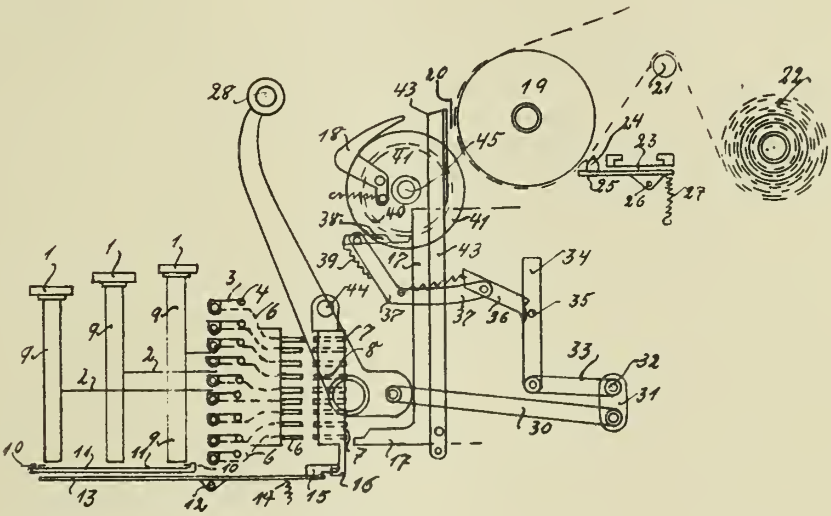

Fig. 1.

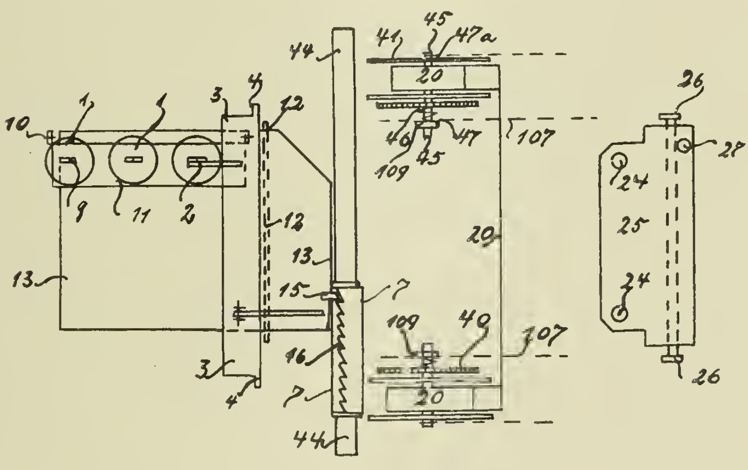

Fig. 2.

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Fig 3

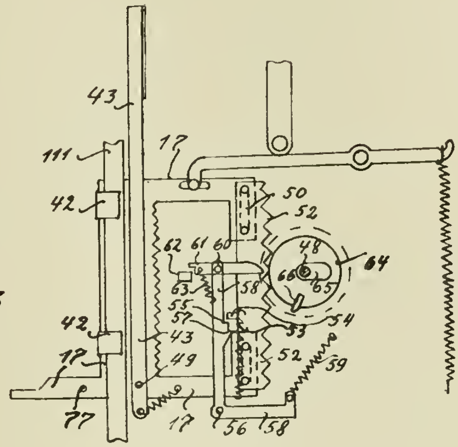


Fig. 4.

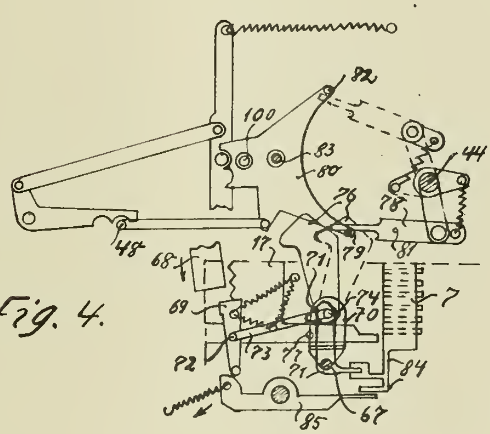
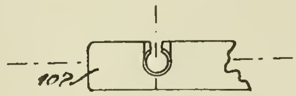


Fig. 5.



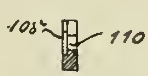


Fig. 7.

Fig. 6.

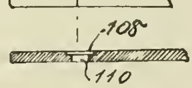
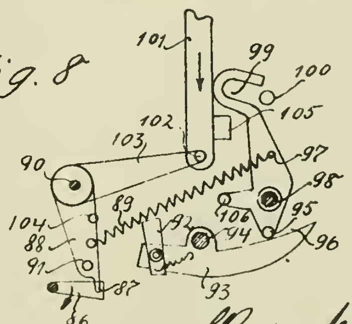


Fig. 8



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Published May 25, 1943

Serial No. 152,008

ALIEN PROPERTY CUSTODIAN

DEVICE FOR CONNECTING SHEET METAL MEMBERS

Gerhard Heim, Sindelfingen, Germany; vested in the Alien Property Custodian

Application filed July 6, 1937

My invention relates to a device for connecting sheet metal members by a spot welding operation and, more particularly, to a device of this type in which the sheet metal members are firmly clamped in position on a set of electrode bars connected to one terminal of a transformer, the other terminal being connected to a second set of electrode bars which are mounted in opposed relationship to the first-mentioned set and cooperate with a movable welding implement brought to engagement with the work piece and adapted to conduct the current therethrough.

In devices of this kind which were known prior to my invention, the two sets of electrode bars of different polarity are mounted in spaced relationship parallel to each other. The movable welding implement is brought to engagement with the work piece at the spots to be welded and is then spread apart until it engages the opposed electrode bar. In this manner, the required welding pressure is produced and the circuit is closed. In order to avoid deformation of the electrode bars under the effect of the welding pressure exerted by the welding implement, each electrode bar is mounted on a heavy steel beam capable of withstanding such pressure and all of the steel beams are interconnected to form a unitary rigid welding frame.

This prior device is objectionable for several reasons. The electrode bars to be engaged by the welding implement interfere in many cases with the insertion and the removal of the work piece and, therefore, must be so mounted on the welding frame as to be capable of ready removal or disassembly. As bending stresses are set up in the beams by the pressure exerted by the welding implement, the beams must be made comparatively heavy and, therefore, constitute a large bulk of magnetic material which causes considerable hysteresis losses since alternating current is ordinarily employed for the welding operation.

The object of my invention is to avoid these disadvantages by an improved arrangement of the electrode bars and of the welding implement to be used in connection therewith. Further objects are to reduce the number and the dimension of the beams constituting the welding frame and to provide an improved welding device in which the electrode bars will not interfere with the insertion and the removal of the work pieces.

I achieve these and other objects of my invention by superimposing the two electrode bars of opposite polarity, a suitable insulator only being interposed therebetween, and by placing them on a simple carrier, for instance on a beam of the welding frame in such a manner that the one electrode bar contacting with the work piece is positioned between the latter piece and the other electrode bar engaged by the welding implement. With this arrangement, the pressure exerted by the welding implement does not set up any stress in the carrier supporting the two electrode bars and the work piece. Hence, the carrier may be made much lighter than it was possible prior to my invention and will cause negligible hysteresis losses only. Also, the carrier will not interfere with the mounting of the work pieces.

Further objects of my invention are to provide an improved welding implement of simple and inexpensive design and simplified manipulation.

Still further objects of my invention will appear from the description of a preferred embodiment following hereinafter and the features of novelty will be pointed out in the claims.

In the drawing, I have illustrated a welding frame designed for connecting the sheet metal components of an automobile frame by a spot welding operation and my improved welding implement in a perspective view, partly shown in section.

The welding frame comprises two longitudinal beams **3** of I-cross-section interconnected by a plurality of transverse beams indicated at **3'**. This frame conforms generally with the shape of the automobile frame composed of a plurality of U-profiled sheet metal members **1** and of substantially plane sheet metal members **2**. The webs of the members **1** have flanges **1'** which intimately contact with the marginal portions of the members **2** and are to be connected therewith by a spot welding operation.

Each element **3**, **3'** of the frame constitutes a carrier for two superimposed electrode bars **4** and **5** which may be in form of comparatively thin copper plates placed on the bars and which are insulated from each other, for instance by interposition of a comparatively thin layer **6** of any suitable insulating material. Suitable connecting means, such as insulated bolts or rivets (not shown), are provided to hold the electrode bars **4** and **5** firmly in position on the frame **3**, **3'**. The frame and the electrode bars are so shaped that they are in intimate contact with each other and with the work piece **1**, **2** at any welding spot. After the sheet metal work pieces **1** and **2** have been placed in proper position on the electrode bars **4**, they are rigidly clamped thereto by suitable means, for instance by clamps each comprising a yoke **7** pivotally connected to the frame at **32**, a clamping screw **33** mounted in the free end

of the yoke and provided with a handle 34, and a shoe 8 of insulating material inserted between the screw 33 and the work piece 1. While I have shown one such clamp only in the drawing, it is to be understood that a plurality of such clamps is provided for instance at all of the points indicated at 35. The two electrode bars 4 and 5 are connected with the output terminals of a transformer (not shown) by suitable conductors 9 and 10.

It is to be understood, of course, that the various electrode bars 5 which are directly placed on the frame 3, 3' are either integral with each other or suitably interconnected by electric conductors. Similarly, the electrode bars 4 are electrically connected, preferably integral, with each other.

The welding implement is adapted to embrace the sheet metal members 1' and 2 and the two electrode bars 4 and 5 and to contact the lower bar 5 and the upper sheet metal member 1' at opposite points to conduct current from one bar to the other through the sheet metal members, whereby the same are heated to welding temperature. For this purpose, any suitable welding implement may be used. However, I have invented an improved device for this purpose which comprises two pivotally connected supports 11 and 14, opposed contact members 12 and 13 mounted thereon, a flexible electric conductor 26 connecting these contact members and means for imparting a pivotal relative movement to the supports 11 and 14. In operation, the contact member 12 is placed on the flange 1' of the work piece and the contact member 13 is placed on the electrode bar 5 from below, whereupon the two contact members are pressed towards each other to produce the required welding pressure. The means for imparting the relative movement may be a simple handle or may be a power-driven mechanism. I prefer, however, to employ pneumatic means and a manually operable valve for controlling it.

In the embodiment shown in the drawing, the two supports 11 and 14 are hollow sheet metal members of U-shaped cross-section having overlapping flanges traversed by a pivot pin 35. The contact members 12 and 13 mounted on the ends of the short arms of the members 11 and 14 are interconnected by a flexible conductor 26, whereas the long arms are connected by a helical spring 36 tending to spread the contact members 12 and 13 apart.

A cylinder 15 is inserted in and suitably attached to the upper member 14 and accommodates a piston 25 which projects from the open lower end of the cylinder 15 and engages a cushion 37 carried by the lower member 11. The cylinder 15 is integral with a threaded bushing 38 which projects upwardly through a hole provided in the member 14 and carries a valve chamber 16 provided with a horizontal bore 17 and with a number of transverse bores 20, 21 and 22. A cylindrical valve member 18 guided in the bore 17 is provided with a knob 39, with a recessed central portion 40 and with an end stud 41 of insulating material. The bore 17 is closed by a cap 42 of insulating material in which two terminals 28 and 29 are mounted. These two terminals are connected by two electric conductors 30 and 31 with a relay or similar mechanism (not shown) controlling the supply of electric current to the conductors 9 and 10.

A flexible bridge member 27 is connected to the terminal 29 and adapted to be engaged by the stud 41 to be pressed against the terminal 28 to close a circuit through the relay or the like, whereby current is supplied to the electrode bars 4, 5. A helical spring 19 surrounds the valve member 18 and tends to move it towards the left. The bore 22 is suitably connected with a pipe 23 leading to a source of compressed air.

After the operator has brought the welding implements to proper position, he depresses the knob 39, whereby the valve member 18 is pushed towards the right to a position in which the space surrounding the recessed portion 40 establishes a communication between the bore 22 and the bore 20. At the same time, the switch constituted by the elements 27, 28 and 29 is closed. The compressed air supplied through the pipe 23 flows into the cylinder 15 and depresses the piston 25, whereby a pivotal movement is imparted to the members 11 and 14 so as to firmly press the contact members 12 and 13 towards each other. The electric current supplied to the conductors 9 and 10 as a result of the closure of the switch 27, 28 and 29 will then flow through the bar 4, the contact member 12 contacting therewith, the flexible conductor 26, the contact member 13, the lower bar 5 and the conductor 10. Consequently, the sheet metal members 1' and 2 will be highly heated at the spot of engagement with the contact member 12 and will be firmly welded together under the pressure exerted by the contact members.

When the welding operation is finished, the operator releases the knob 39, whereupon the spring 19 restores the valve member 18 to the initial position shown in which the cylinder 15 is connected with the exhaust conduit 21 thus permitting the spring 36 to spread the contact members 12, 13 apart. Then the operator applies the implement to the next spot to be welded.

The superimposed bars 4 and 5 project beyond the beam 3 or 3' at the welding spots to present an unobstructed face to the contact member 13 for engagement therewith. Preferably, the beam 3, 3' is recessed for this purpose, as shown at 43.

As the two electrode bars of different polarity are supported by the same beam and as this beam is not subjected to any stress produced by the welding pressure, it is obvious that the beams of the welding frame may be made much thinner than it was possible prior to my invention. Owing to the reduction of the mass of steel, the hysteresis losses are minimized. The work pieces may be put in position without requiring disassembly of the electrode bars.

GERHARD HEIM.

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G. HEIM

DEVICE FOR CONNECTING SHEET METAL MEMBERS

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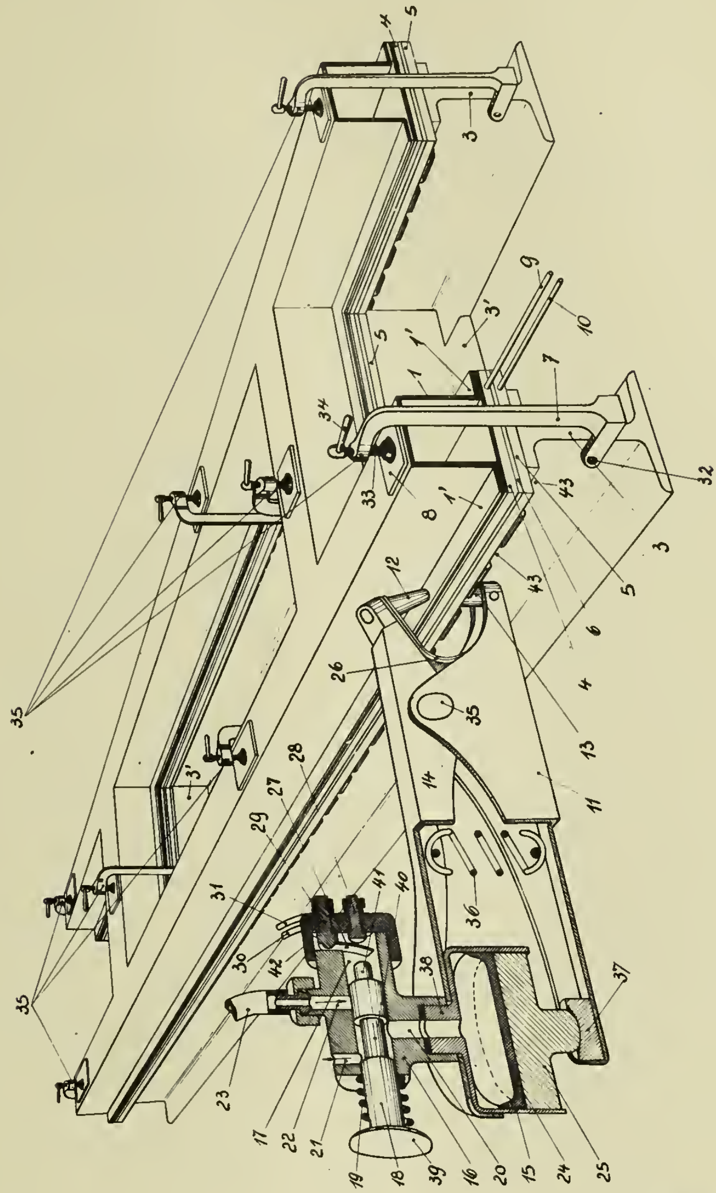

Inventor

Gerhard Heim

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ALIEN PROPERTY CUSTODIAN

PURIFICATION OF WATER

Eugène Joseph Desroches, Courbevoie, France; vested in the Alien Property Custodian

Application filed August 30, 1937

This invention, due to Mr. Eugène Desroches, relates to the purification of water.

The object of the invention is to provide a purification process which consists in causing water to be purified to pass over cellulose, in loose condition or otherwise, or over bodies the main ingredient of which is cellulose, or similar materials, such as asbestos, the passage of water through the mass of cellulose or the like being accompanied by a more or less intense aeration, the direction of flow of the air being the same as that of the water.

As cellulose or body the main ingredient of which is cellulose, use is made of rags, paper, cellulose wool, etc.

It has been found that this purifying process, particularly simple, is of great efficiency for the treatment as well of water adapted to be used for drinking purposes as of so-called waste water.

In particular, it has been recognized that this process allows, by its previous application, to bring waters considered up to now as very difficult to treat, to such a condition that their subsequent treatment or filtration by the various known processes (in particular by the process according to the United States Patent of January 22nd 1937, in the name of Mr. Desroches, for: "Method of filtering and treating water and systems and apparatus for the application of this method") is thereby greatly facilitated and accelerated.

It has also been recognized that the purifying process according to the invention allows in itself, in many cases, to convert a natural water unsuitable for consumption into a water satisfying all the conditions of hygiene.

It will be understood that, for the purification of water adapted to be used for drinking purposes, white rags or white paper, or even cellulose wool are preferably chosen, in case these substances are employed, in order to avoid coloration of the purified water.

In case of purification of waste water, the choice of the materials the main ingredient of which is cellulose may not be so strict; thus, use may be made of town refuse, or garbage, but containing cellulose in high proportions.

It may also be economical to associate these various purifying agents, by constituting the purifying layer by superpositioning of elementary layers, for instance successively, starting from the bottom, of cellulose wool, washed rags, unwashed rags, garbage.

The sole use of garbage results in a water preserving a relatively noticeable coloration, so that garbage is only employed for the purification of waste water.

For certain waters difficult to treat, it is advantageous to introduce, before their passage over cellulose, ingredients facilitating subsequent treatment. As ingredients may be cited, by way of example, natural carbonate of lime, alumina hydrate, ferric hydrate, alumina sulphate, perchloride of iron, etc.

On the other hand, it is advantageous, in some cases to subject the cellulose to a preliminary treatment which is most often a surface treatment carried out by application of a process similar to dyeing: the cellulose is thus impregnated with various bodies, such as alumina, carbonate of lime, permanganate of potash, ferric hydrate, alumina silicate, etc.

For this operation, one may start from the colloids themselves, or the reaction can be carried out on the cellulose; for instance, the cellulose can be impregnated with alumina sulphate and subsequently washed with a strong base or a soluble silicate, or the cellulose can be impregnated with acidulated water and subsequently washed with a soluble aluminate or a soluble silicate, or again the cellulose can be impregnated with a strong base and washed with an iron salt.

The cellulose thus treated can intervene, for purification purposes, alternately with pure cellulose, by placing for instance, a layer of pure cellulose, a layer of "dyed" cellulose, etc.

Other materials have purifying properties similar to those of cellulose and of asbestos. These materials, which are very numerous, must have the following properties:

Be insoluble in water,

Be in a very divided condition so as to present a very large surface of contact,

Have a great adsorbing power, or at least an adhesive power,

Be in such a condition that, when in layers, they are sufficiently pervious to water and to air under a small pressure.

As mineral materials can be cited, by way of nonlimitative examples: mineral wools, for instance slag wool of blast furnaces, sands, certain coals and pulverized clinker, etc., as organic materials, the natural or artificial ternary products similar to cellulose (cellulose wool, alfa moss, etc.).

The purifying layer can include not only various layers of different kinds of cellulose, but also layers of different mineral bodies or even of mineral bodies and of organic bodies, this for the purpose of utilising the particular adsorbing

properties which may be different relatively to certain impurities of the waters to be treated.

The invention also relates to an apparatus for carrying into practice the process above defined. This apparatus, under its various forms of construction answering to the various forms of carrying the process into practice, is characterised by the presence of a mass of cellulose or of other bodies as indicated above on which is supplied the water to be purifed and from which flows the purified water, and by means allowing aeration of this mass humidified by water, in course of the purifying operation.

This apparatus can be preceded by a distributor of ingredients; however, for the sake of economy, these ingredients can simply be arranged, in a divided form, at the upper part of the mass of cellulose or other body indicated above, or they can be interposed in this mass.

In some cases, the starting of an apparatus causes an operative phase to intervene during which initiation of the fermentations takes place; the water which passes through the apparatus during this phase can then be returned to the untreated water circuit for a further passage which completes its purification.

After a certain time of operation, the apparatus must be regenerated; most often, this regeneration is simply effected by cutting off the supply of untreated water and by maintaining the aeration.

When this regeneration is no longer possible, the cellulose or other similar bodies removed from the apparatus and washed in order to constitute a new active layer, or it is replaced by active cellulose or other similar active body. If the water is highly laden with Az, the cellulose or the like is left in the apparatus; the supply of untreated water is definitely cut off and the aeration is controlled so as to obtain humidification of the exhausted cellulose or the like and the drying of the mould obtained.

When the adsorbing materials are arranged according to a relatively great thickness, the regeneration of the apparatus can be effected, after having cut off the water supply and maintained the air suction during the time necessary for obtaining a first drying, either, if only an abnormal increase of the loss of pressure of the air by loosening (by hand or mechanically) of the upper layer, or, on the contrary, if the quality of the water has become insufficient or if the operation above mentioned has proved to be inoperative, by simply removing this layer which is the most heavily laden, and by allowing the subjacent layers to subsist.

If the adsorbing materials are of a mineral nature, they can be regenerated by heating (without contact with air if the material employed is combustible or if ignition of the gases produced is feared) after they have been removed from the apparatus.

If said adsorbing materials are of an organic nature, they are placed in a fermentation cell similar to those used for the fermentation of garbage or household refuse.

Three forms of construction of an apparatus for carrying into practice the process according to the invention are described hereinafter, by way of examples, with reference to the accompanying drawing, in which:

Fig. 1 diagramatically illustrates a preliminary apparatus according to the invention.

Fig. 2 diagrammatically shows the combination of a preliminary apparatus and of a filter.

Fig. 3 illustrates an overhead preliminary apparatus.

Fig. 4 illustrates a battery of such preliminary apparatus.

The preliminary apparatus (Fig. 1) comprises a chamber 1 open at its upper part, and limited at its lower part by a grate 2. In the chamber 1 are piled up, for forming a mass 3, bodies made of cellulose or the main ingredient of which is cellulose, or chosen among those indicated above.

The untreated water is supplied by a pipe line 4 provided with a control cock 5. In important installations a distributor ensures satisfactory distribution of this untreated water. Eventually, a distributor 6 allows the distribution of the ingredients in the water of pipe line 4.

The interior of chamber 1 is connected to a suction device (not shown) the action of which is adjustable, through a pipe 7 opening below the grate 2.

The purified water is collected in a pipe 8 connected to a discharge pipe line 9.

Eventually, a return circuit 10 can be provided between the pipe line 9 and the upper part of chamber 1. In this circuit is interposed a pump 11 sucking water from pipe line 9 and delivering it above the mass 3. This pump is used upon starting of the apparatus, during the phase of initiation of the fermentations.

A pressure gauge 12 and an apparatus for measuring the output allow of controlling at every instant the intensity of the suction.

Fig. 2 diagrammatically illustrates the combination of a preliminary apparatus and of a filter.

The untreated water is contained in a tank 13 from which it flows through a cock 14. In more important plants, the untreated water is directly admitted through a supply pipe line.

The tank 13 is located above the preliminary apparatus; the cellulose 15, or the like, is held in chamber 16 between two grates 17 and 18. The suction of the air is effected through a pipe 19; in small plants, this suction is simply effected by the draught produced by a lighted lamp; in other plants, the suction is obtained by means of a fan.

The base of chamber 16 is provided with a siphon 20 through which it communicates with a filter 21. The latter is, for instance, of the type described in the United States Patent application January 22nd 1937, in the name of Mr. Desroches. In the form of construction illustrated, it is constituted by a support 22, in the shape of a ring, to which is attached a cloth 23, of a colloidal nature (wool, silk, cotton, asbestos, etc.).

The bag constituted by the cloth 23 is filled with cellulose or with substances the main ingredient of which is cellulose or the like. The colloid or colloids for the formation of the membrane on the cloth 23 are poured through a funnel 24 connected to the lower part of chamber 16 through a pipe 25.

The filtered water falls in a tank 26 from which it can be extracted through a cock 27. In small filters, this tank is conveniently constituted by a vessel made of porous material for obtaining fresh filtered water.

In large plants, the tank 26 is dispensed with, the filtered water directly flowing in a discharge pipe line.

For cleaning the cloth 23, the latter is removed from the supporting ring 22.

Fig. 3 shows a form of construction of an overhead preliminary apparatus. The chamber 28

acts as an aeration column. It contains, at its lower part, a perforated ring or a perforated spiral **29** or better sleeves made of cloth through which compressed air is distributed. The latter comes from a pipe line **30** in which are interposed apparatus **31** for measuring the head and the air output.

The untreated water enters the base of the column through the pipe **32**. This water is aerated during its passage through said column. The air in excess escapes through an automatic vent **33**; an independent cock **34** is also provided for that purpose.

The washing of the column is effected through an orifice **35** provided at the lower part of the latter.

The column or aerator is connected to the preliminary apparatus proper through a pipe line **36** from which extend:

(*a*) A by-pass pipe **37** for the introduction of solid ingredients through the funnel **38**, a vent **39** being provided on this by-pass pipe;

(*b*) A pump **40** sucking liquid ingredients in a vat **41** and provided with a return pipe **42** for controlling the outflow.

The pipe line **36** leads to the base of the preliminary apparatus in front of a flange **43** acting as a deflector. The preliminary apparatus is constituted by a chamber **44** at the base of which is arranged a large mesh support **45**, for the cellulose or substance the main ingredient of which is cellulose or the like.

The water to be purified passes upwardly through this chamber **44**. At the upper part of the preliminary apparatus, this water encounters a cloth **46**, of a colloidal nature, on which a filtering membrane has been formed by means of gels poured in the water to be purified by application of the process forming the subject-matter of the United States Patent application filed on January 22nd, 1937, in the name of Mr. Desroches. The purified water issues through a pipe line **47** on which is provided an automatic vent **48** with an independent cock **49**. Eventually a supplementary introduction of compressed air can be provided at the base of the preliminary apparatus.

Two pressure gauges are provided at the inlet and at the outlet, respectively, of the preliminary apparatus.

The washing of the latter is effected by means of a connecting branch **52** and a lower orifice **53**; the discharge of the cellulose is effected through a connecting branch **54** and a man hole **55**.

Fig. 4 shows a battery constituted by three devices such as that which has just been described. The untreated water is supplied by a pipe line **56** and is distributed in the three groups, arranged in parallel, of aerators **57** and preliminary apparatus **58**. The purified water issues through a pipe line **59**. Cocks **60** allow to put in service the desired number of groups.

EUGÈNE JOSEPH DESROCHES.

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E. J. DESROCHES

PURIFICATION OF WATER

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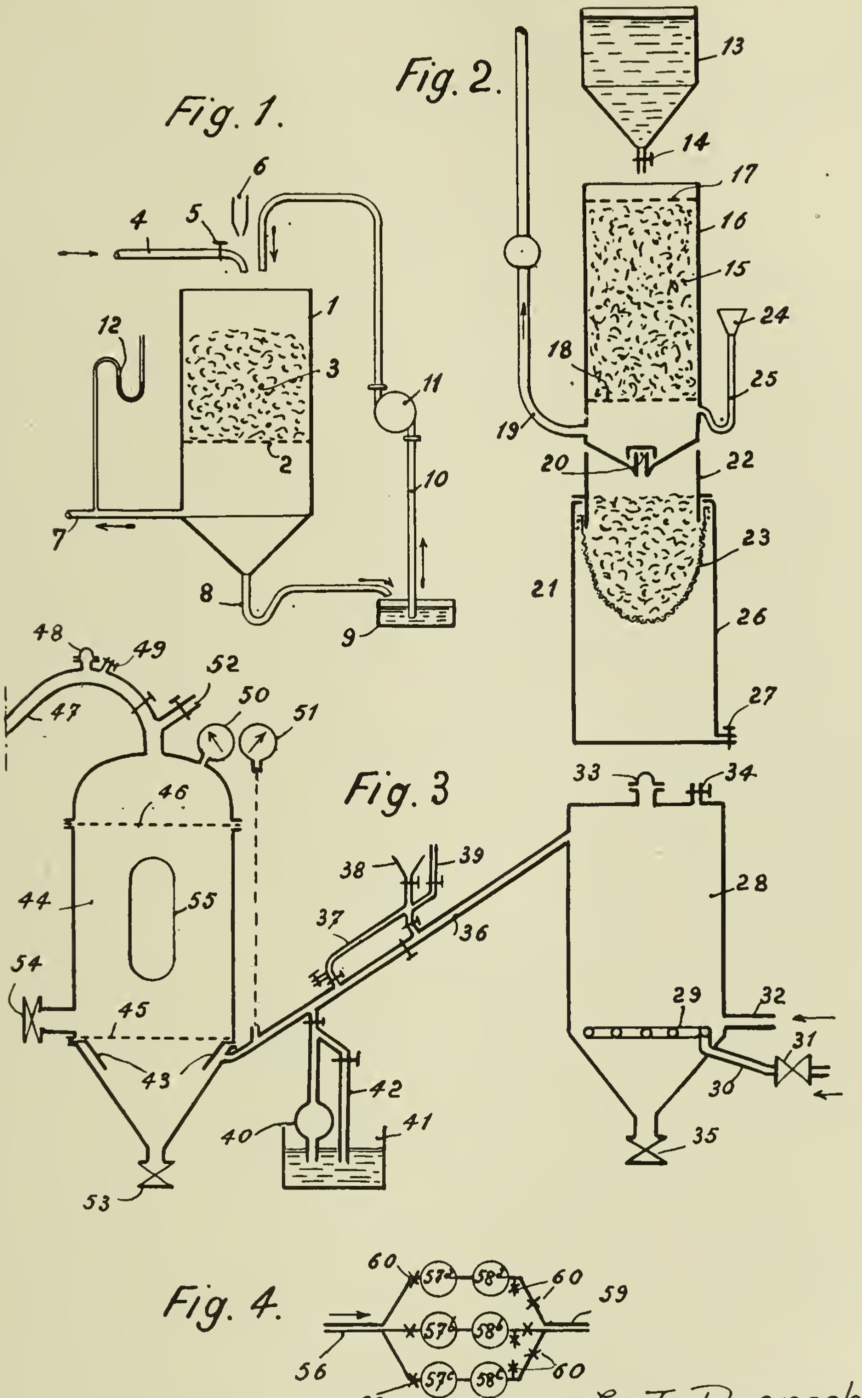

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ALIEN PROPERTY CUSTODIAN

CALCULATING AND REGISTERING MACHINE

Ulrich Eichler, Glashutte, Germany; vested in the Alien Property Custodian

Application filed November 2, 1937

This invention relates to a new and improved calculating machine having a built-in registering or recording device.

Calculating machines, especially machines for the four branches of arithmetic, with a device for registering or printing the calculated amounts are known. In machines of this kind, the arrangement is made in such a way that the setting of an amount by the keys of the calculating machine is, on being transferred to the calculating mechanism, likewise simultaneously transferred to the registering device.

The present invention starts from this form of construction. In contrast to the devices of this kind in which not only the individual items set by the keys but also the individual results of the calculations are registered, consequently requiring a very complicated constructional design, the invention is concerned with the task of determining the individual addition or subtraction items only by means of the registering device and registering the total result at the end of the calculation. This can be effected in a simple manner by transferring the total result to the key mechanism and again introducing it into the calculating mechanism subtractively. This results in producing the zero position in the totalizer with simultaneous registering of the total result in the registering device.

The entire construction is simplified as a matter of course by this device. According to the invention, a further simplification is attained by making use of one and the same motor drive or hand drive for the calculating mechanism and the registering mechanism. The registering mechanism is coupled to or disengaged from the drive of the calculating mechanism by means of a shift lever. A gearing may also be interposed in order to reduce the present customary high speed of the drive shaft when registering.

It is advisable to provide a hand lever by means of which the shaft activating the registering device may be coupled to or disengaged from the main calculating shaft. In this way it is possible to combine the registering device with the setting keyboard under the control of a single handle so that, during the transfer of the keyed or set amount to the totalizer, the amount is simultaneously printed or recorded on the paper tape.

When there is present a reducing gearing that reduces the operating speed of the machine when there is simultaneous registering, it is an object of the invention to likewise operate by the said hand lever the couplings for the connection and disconnection of this reduction gearing.

When the type rollers are set by slidable members that cooperate with stepped setting members which are in connection with the keys of the keyboard, it is an object of the invention to give the stepped setting members the form of rocking levers. This presents the advantage of sure guidance with the simplest constructional means.

Furthermore it is an object of the invention to provide an arrangement whereby the type is securely attached to type rollers or the like and to provide such type rollers with one or more blank type spaces in addition to the ten type from "0" to "9."

It is a further object to provide means to maintain the type rollers of the decimal points positioned in advance of the actual amount in such a position that they set the blank types opposite the registering or platen cylinder, and to set the "0" type of the type rollers for the decimal points positioned within the amount opposite the registering or platen cylinder when such keys are not manipulated. This results in only those parts of the amount being registered that belong to the amount itself and consequently avoids the positioning of zeros in advance of the amount itself, which would affect the easy legibility of the registering.

With the above and other objects in view which will become apparent from the detailed description below the invention resides in the combination and arrangement of elements hereinafter set forth in detail and shown in the drawings in which:

Fig. 1 shows a top view of a preferred embodiment of the invention.

Fig. 2 shows a vertical cross section taken along the section line II—II of Fig. 1, a portion being cut out at the point indicated by X.

Fig. 3 shows a side view of Fig. 2 as seen in the direction of the arrow x with the registering apparatus omitted.

Fig. 4 shows a portion of Fig. 2 in another working position of the parts.

Fig. 5 shows a side view of Fig. 4 in the direction of the arrow in Fig. 4.

Fig. 6 shows a vertical cross section taken along the section line VI—VI of Fig. 1.

Fig. 7 shows a partial side view as seen in the direction of the arrow z in Fig. 1.

Fig. 8 shows a similar view as Fig. 7 but illustrating other details.

Fig. 9 shows the parts shown in Fig. 8 in a

different working position with the main parts of the actual calculating mechanism being included.

Fig. 10 shows a partial sectional view of a detail taken along the section line X—X of Fig. 7.

Fig. 11 shows a partial side elevational view of a modification.

First of all the parts of the calculating machine shown in Fig. 1 will be described.

The calculating mechanism

1 indicates the keyboard which, in the calculating of addition, for example, serves for the setting of the digits. The carriage 2 displaceably installed on the machine frame carries the revolutions counter 3 and the totalizer 4. 5 indicates the two carriage shift keys. The clear key is designated by 6, the quotient and division levers by 7, the addition key by 8 and the subtraction key by 9.

In the embodiment illustrated, the calculating machine has a keyboard 1 consisting of nine banks of keys. Each of these banks of keys comprises a plate 10 (Fig. 2) secured to the machine frame and having positioned in it nine key slide bars 11 that are vertically displaceable. These key slide bars 11 are provided with key buttons 12 that carry the figures "1" to "9". The bottom ends of the key slide bars 11 are carried in a plate 13 which is connected with the plate 10.

On each of the key slide bars 11 there is located a roller 14 which cooperates with a bar 15. The bar 15 is connected with the link 16 and the lever arm 17 in articulated parallelogram fashion. While the link 16 is pivoted to the plate 13 by means of the pin 18, the lever 17 is oscillatably mounted on the plate 13 by means of the pin 19. To the lever arm 17 there is integrally secured a lever arm 17' with the top end of which a roller 20 cooperates. The roller 20 is mounted by means of the pin 21 on an extension 22' of a slide 22. Each plate 10 is provided with a slide 22, and these slides 22 have fork-like claws 23 which set the gears 24.

The gears 24 are axially displaceable but non-rotatably mounted on the rectangular shafts 25 which carry the bevel gear supports 26 (see Fig. 9). These bevel gear supports 26 are longitudinally slidable but non-rotatably mounted on the shafts 25. All the supports 26 are jointly controlled by a bar 28, and all the bevel gear supports 27 that are similarly monted on the shafts 27^3 are controlled by a bar 29. According to whether the bars 28 and 29, as shown in Fig. 9, are displaced to the right or to the left, the bevel gears 26', 27' or 26'', 27'' come into engagement with the bevel gears 30 or 31 respectively of the totalizing mechanism or the revolutions counter mechanism. The bevel gears 30 and 31 are mounted for rotation on shafts secured on the carriage 2 and are connected with the number wheels 30' or 31' respectively.

When the bars 28 and 29 are displaced to the right so that the bevel gears 26' and 27' come into engagement with the gears 30 and 31 respectively, then the number wheels 30' and 31' are turned in a clockwise or positive direction while on displacement to the left, when the bevel gears 26'' and 27'' come into action, the number wheels are turned counterclockwise or in a negative direction. The number wheels 30' and 31' show through the windows 3' and 4' of the totalizing and revolutions counters. A stepped roller 32, as is customary in Thomas calculating machines, is secured on a shaft 33 positioned parallel to the shaft 25 (Fig. 2). On each shaft 33 there is secured a bevel gear 34 that is in engagement with a bevel gear 35. All the bevel gears 35 of the calculating mechanism are secured on the main calculating shaft 36. The shafts 33 are in connection by means (not shown) with the shafts 27^3 of the revolutions counter mechanism.

Operation of calculating mechanism

The arrangement and mode of operation of the device just described is such that when, for example, the key having the insignia "5" (Fig. 1) is depressed, the roller 14 (Fig. 2) of the respective key slide bar 11 will strike against the bar 15 and tilt the lever system 16, 17 and 17' in such a way that the bar 22 is so operated as to set the respective gear 24 opposite that portion of the stepped roller 32 that has five teeth.

The key slide bars 11 are under the influence of tension springs (not shown) which tend to push back the key slide bars into the initial position, as shown in Fig. 2. In the depressed position, the key slide bar is held by the locking bar 37, as shown in Fig. 2, which is pulled to the right by means of a spring (not shown). Each bar 22 has a hook-shaped plate 38 which is engaged by a tension spring 39 which is secured at the other end to a hook 40 on the plate 10. By means of this tension spring 39, the roller 20 is always held against the lever 17'.

The register setting mechanism

According to the invention each of the two-armed levers 17, 17' is provided with a third arm 17'' to the bottom end of which one end of a bar 42 is pivoted at 41. The other end of the bar 42 is pivoted to a plate 40 by means of the pin 43. As many plates 40 are provided as there are levers 17''. All the plates 40 are suspended in pendulum fashion by means of pivot pins 44 installed on the machine frame.

Each plate 40 cooperates with a lever 45, the top end 45' of which bears against a laterally projecting pin 46 provided on the plate 40. Tension springs 47 which are secured at one end by means of the pins 48 to an obtuse-angled bent plate 49 hold the levers 45 in contact with pins 46.

The plate 49, which is secured to the machine frame by means of screws 50, is provided with parallel guide slots for the plates 40. The levers 45 are pivotally mounted on the common shaft 51 which is secured to the machine frame. At their lower ends, the levers 45 are provided with finger-like projections 52 which project through a corresponding slot 53' in the frame wall 53.

Furthermore each plate 40 cooperates with a bar 54 which is held vertically displaceable between three comb-like bars 55. The bars 55 are secured by means of the rectangularly bent flaps 55' between two frame plates 56 which are attached to the machine frame by means of angle pieces 57. On the bars 54 there is secured on each an extension 58, with the pin-like end 58' to which one end of a tension spring 59 is attached. The tension springs 59 have their other ends secured to the cross rod 60 that extends between the extensions 56' on the two frame plates 56.

Over all the extensions 58 there engages a bolt 61 the ends of which are secured to one of the ends of the levers 62 which have the form of double armed levers. The levers 62 are secured on the rocking shaft 63 which is mounted in the machine frame. Each of the levers 62 is engaged by a strong tension spring 64, which acts opposite

to the spring 59 and tends to apply the levers 62 against the top edge of the frame plate 53.

The levers 62 contact at their under sides the rollers 65' which are provided with a groove therefor and these rollers are pivoted at one of the ends of the two levers 65. The levers 65 are fixed on a rocking shaft 66 positioned in the machine frame. On the rocking shaft 66 there is also fixed a lever arm 67 which is pivotally connected at 67' to the rod 68 whose other end is pivoted to the crank pin 69. The crank pin 69 is secured to the crank 70, the boss 70' of which is positioned rotatably and displaceably on the shaft 71. The boss 70' of the crank 70 is provided with an annular groove 72 in which the shift claw 73 engages. This shift claw is secured to a lever 74 the top end of which is shaped like a handle 75 and which is positioned rockably in the machine frame by means of the pin 76. The bottom free end 74' of the lever 74 engages in a hole 77' of the bar 77. The bar 77 is pivoted on the machine frame by means of the pin 78. The free end 77'' of the bar 77 engages in the annular groove 79 of a coupling member 80.

Coupling of registering mechanism with calculating mechanism

The drive of the machine is effected by the electric motor 81, the connecting in of which is effected by a contact arrangement that is activated on depressing one of the keys 5 or 8 or 9. On the shaft 82 of the electric motor there is fixed a spur wheel 83 which meshes with a spur wheel 84. The spur wheel 84 is freely rotatable on the shaft 85 secured in the machine frame. Connected with the spur wheel 84 there is a boss 86 provided with coupling claws 86'. In engagement with the spur wheel 84 there is also a spur wheel 87 which rotates a further spur wheel 88 on the common shaft 89. The shaft 89 is rotatably mounted in the machine frame. In engagement with the spur wheel 88 there is a spur wheel 90 which is likewise freely rotatable on the shaft 85. Connected with this spur wheel 90 there is a boss 91 provided with coupling claws 91'.

The coupling member 80 is provided with coupling claws 80' designed to cooperate with the coupling claws 86'. Connected with the coupling member 80, there is also a sprocket wheel 92 having a boss 93 which is provided with coupling claws 93'. The coupling claws 86' are in engagement with the coupling claws 80', or the coupling claws 91' with the coupling claws 93', according to whether the coupling member 80 actuated by the lever 77 is in the right end position due to a movement of the hand lever 74 as seen in Fig. 1, or is in the left end position. When the coupling claws 86' and 80' are in engagement, the motor shaft 82 is directly connected with the coupling member 80 via the spur wheels 83 and 84. But if the coupling member is displaced to the left in Fig. 1 so that the coupling claws 91' and 93' are in engagement with each other, then the coupling member 80 is connected with the motor shaft via the connecting gearing 87—89 and the gears 83, 84 and 90.

When the coupling member 80 is engaged through gearing 87—89 there is a gear reduction of about 3 to 1 over a direct connection of the coupling member with the spur wheel 84.

The sprocket wheel 92 is connected by the chain 94 with another sprocket wheel 95 which is mounted on the pin 97 that is secured on the frame plate 96. Connected with the sprocket wheel 95 there is a spur wheel 98 which is in engagement with the spur wheel 99. The spur wheel 99 is freely rotatable on the pin 100 which is likewise secured to the frame plate 96. The spur wheel 101 that is located on the main calculating shaft 36 is in engagement with spur wheel 99, and there is another spur wheel 102 in engagement with spur wheel 101. Spur wheel 102 is freely rotatable on the shaft 71 and is provided with coupling claws 102'.

If, by means of the lever 74 and the shift claw 73, the boss of the crank 70 is displaced to the right in Fig. 1, then the coupling claws 102' engage in corresponding recesses 72' of the boss 72, thus resulting in coupling of the crank 70 with the spur wheel 102. During the necessary rocking of the lever 74 for this purpose, the lever 77 is, by means of the pin 74', moved on the pin 78 to the left of Fig. 1. This however brings the coupling claws 80', 86' out of engagement and the coupling claws 91', 93' will engage each other, so that the drive coupling member 80 is switched to slower speed.

Release of registering mechanism

For the handle 75 of the lever 74 that projects upwardly out of the machine, a slot is provided in the top wall of the frame, as shown in Fig. 1. The letter S is provided at the right end of the slot and the letter R at the left end of it. These letters indicate that the machine is set for calculating when the handle 75 is in the left position, while the machine is set for simultaneous registering and calculating when the handle 75 comes into the right hand position.

Assuming that the handle 75 is in the last-mentioned position, then when the electric motor is set in operation, the crank 70 is also set in rotation simultaneously with the main calculating shaft 36. This causes the levers 65, 67 to swing out by means of the rod 68 and presses the double lever 62 upwardly into the position shown in dotted lines in Fig. 2. This results in the cross rod 61 releasing the extensions 58, so that the bars 54 are subjected to the springs 59.

Setting of type rollers

On each of the bars 54 there is furthermore secured a plate 103 which has a nose 103' provided at its edge. This nose extends into the plane of that plate 40 that pertains to the respective bar 54. Under each plate 40 there is furthermore installed a rocking plate 104 which has the form shown in Figs. 2, 4 and 6. The plates 104 are rockably positioned on the common shaft 104^5 which is secured to the machine frame. Each plate 104 is engaged by a tension spring 104^6 which tends to rock the plates 104 of Figs. 2, 4 and 6 to the left.

Furthermore, as shown in Figs. 3 and 5, each plate 104 is provided with a tongue 104' bent rectangularly from the plane of the plate, which tongue extends into the range of movement of that extension 58 that is installed on the corresponding bar 54. Thus, when the double lever 62 is in the bottom position (see Fig. 2), all the plates 104 are drawn back somewhat to the right by the extensions 58 against the pull of the springs 104^6. In this position of the plates 104, the finger-like extensions 52 swing upwards in the manner indicated by dotted lines in Fig. 2, provided of course that the levers 45 are released from the pin 46 swinging to the left, so that they come to be located in front of the angularly bent flaps 104''.

Furthermore, each of the plates 104 is provided

with a flap-like extension 104^3 which is bent off obliquely from the plane of the plates 104 in the manner shown in Figs. 3 and 5. The flaps 104^3 are given such a shape that their ends engage back of the adjoining plates 104 of the next higher decimal places. In this way it is contrived that when, for example as shown in Fig. 5, the fourth plate 104 from the left is prevented from swinging in by the extension 52, it also holds back the other plates located to the left of it. Say the said decimal place indicates the thousands, then the plates corresponding to the hundreds, tens and units will also be held back simultaneously.

At the top edge of the plates 104 there is furthermore provided a nose-like projection 104^4 which, when the plate 104 is in its extreme left position (see Fig. 4), extends into the range of movement of the nose 103' and prevents its upward movement.

The bars 54 are each provided with a toothed rack 54'. In engagement with these racks there are toothed gears 105 which are each secured on the flanks of a type roller 106. All the type rollers 106 are positioned on the common shaft 107 which has both ends secured in the frame plates 56. Here, as can be seen from Figs. 3 and 5, there are arranged alongside each other nine type rollers corresponding to the number of banks of keys. Each of the type rollers is provided with two blank spaces 108 and with ten digit types "0–"9." These figures are applied on the front sides in such a way that the figures, beginning with "0," are arranged counter-clockwise.

The result registering mechanism

Referring to Figs. 3 and 5, there is installed on the left side along with the type rollers 106 still another type roller 109 which carries the − sign and the = sign at the points indicated in Fig. 8. The type roller 109 is connected with a toothed gear 110 which corresponds to the toothed gears 105 and is in engagement with a toothed rack 111' which is carried by a bar 111 that corresponds to the bars 54. The bar 111 is provided with a plate 112 which corresponds to the plates 103 and carries the nose 112'. Furthermore the bar 111 has also an extension 58 on which a spring 59 engages. The nose 112' extends into the plane of a two armed lever 113 which is mounted on the pivot 44. The bottom end of the lever 113 is equipped with three stepped portions 113', 113'' and 113^3 and with a finger-like extension 113^4. In the position of rest of the lever 113, this extension is applied by means of a tension spring 115 against the plate 49 which carries a guide slot for the lever 113.

Coupling of result registering mechanism with calculating mechanism

Into the range of movement of the lever 113 there extends a rod 116 (see Fig. 9) which is held longitudinally displaceable in the sleeve 117 secured to the machine frame. Encircling the rod is a pressure spring 118 which bears at one end against the sleeve 117 and at the other against a ring 119 secured on the rod 116. This spring 118 tends to apply against the right hand end of the sleeve a ring 120 that is secured on the rod 116. The other end of the rod 116 cooperates with a lever 121 that is secured on the rocking shaft 122. This rocking shaft 122 is connected by means of pins 123 with the shift bar 28.

On the rocking shaft 122 there is furthermore secured a plate 124 which carries the two pins 124' and 124''. With these two pins there cooperates alternately the shoulder 125' or 125'' respectively of a push rod 125 which is mounted at 126 in plate 127. On the plate 127 there is located a roller 128 which cooperates with a cam disc 129 that is positioned on the shaft 36. On one rotation of the shaft 36, the roller 128 is forced out of the position 129' and the plate 127 is thereby rocked against the pull of the spring 130. Thereupon the push rod 125 is tilted once to the right and back again. As can be seen from Fig. 9, the plate 124 is moved clockwise or counterclockwise according to whether the shoulder 125' cooperates with the pin 124' or the shoulder 125'' with the pin 124''. By means of the pins 123, the bar 28 is thereby pushed either to the right or to the left.

If the bar 28 is pushed to the right so that the bevel gears 26' enter into engagement with the bevel gears of the totalizer mechanism, then the coupling is effected in a positive sense whereas, on shifting of the bar to the left, the bevel gears 26'' enter into engagement with the bevel gears 30, resulting in a negative activation of the totalizing mechanism.

The setting of the push rod 125 is effected by the double armed lever 131 which is positioned on the rocking pivot 132. The free forked end of the double armed lever 131 engages over a pin 133 which is installed on the rod 134. One end of the rod 134 with its slotted hole 134' engages around a guide pin 135 provided on the machine frame, while the other end is connected with a lever 137 by means of the pivot 136. The lever 137 is connected with a further lever 138 which is rockably positioned on the pivot 139 provided on the machine frame. Cam surfaces 137' and 138' are provided at the ends of the levers 137 and 138.

Above the levers 137 and 138, the key levers 140 and 141 which carry the keys 8 and 9 are pivotally mounted at 142. On the key lever 140 which carries the key 8 there is provided a bolt 140' which extends into the plane of the cam surface 137'. On the lever 141 which carries the − key there is installed the bolt 141' which extends into the plane of the cam surface 138'.

Operation of result registering mechanism

If the − key 9 is depressed, then the bolt 141' bears against the surface 138' as the lever 141 rocks downwardly. Thereupon the levers 138 and 137, as shown in Fig. 9, are rocked to the right against the pull of the spring 143. By this pivoting of the lever, the bar 134 is pushed to the right and the double arm lever 131 is tilted in the direction of the arrow in Fig. 9. The push rod 125 is thereby moved downwardly to such an extent that its shoulder 125'' comes in front of the pin 124''.

Owing to the outward pushing movement of the push rod 125 produced on rotation of the main shaft 36, the plate 124 is moved in the direction of the arrow in Fig. 9, so that the bar 28 moves the corresponding gear supports 26, as shown in Fig. 9, to the left and the bevel gears 26'' come into engagement with the totalizer mechanism bevel gears 30. During this movement of the plate 124, the rod 116 is, by means of the lever 121, displaced to such an extent to the right against the pressure of the spring 118, as shown in Fig. 9, that the lever 113 is moved into the position shown in dotted lines in Fig. 9 in which the stepped portion 113'' comes to be located within the range of movement of the nose 112'.

Furthermore there is secured to the lever 113

a pin 144 which extends into the plane of movement of a finger-like extension 145′, on a lever 145 that is pivoted on the machine frame at 146 and is provided with a handle 147. The lever 145 is equipped with two socket holes 148 and 149 with which a pin 150 cooperates. This pin 150 is mounted on a spring 151 that is secured to one of the frame plates 56 by means of the screws 152.

If the lever 145 is moved by means of the handle 147 into the dotted line position shown in Fig. 8 so that the nose or pin 150 of the spring enters the socket 148, then the double armed lever 113 is simultaneously brought, against the pull of the spring 115, into the dotted line position shown in Fig. 8. The step 113^3 is thereby brought within the range of movement of the nose 112′.

The printing apparatus

The printing apparatus cooperating with the type rollers 106 and 109 consists of two parallel plates 153 which are positioned by means of the trunnion 154 on the two projections 56′ of the frame plates 56. The platen cylinder 155 is positioned on the interconnected plates 153 by means of the shaft 156. The paper tape 158 coming from the reel 157 is led over this cylinder with a guide cylinder 159 being inserted between the reel 157 and the cylinder 155. The axle 160 of the reel 157 is located in easily exchangeable position in corresponding slots 161 in the plates 153.

The tape coming from the platen cylinder 155 is wound on the winding reel 162, the axle 163 of which is likewise located in easily exchangeable position in two slots 164 in the plates 153. In front of the platen cylinder 155 there is installed the inking cylinder 165, the shaft 166 of which is carried at the ends of two spaced levers 167. The other ends of the levers 167 are secured on a shaft 168 which is positioned in the plates 153. One of the plates 153 is engaged by one end of a tension spring 169 and the other end of the spring is secured to the end of a lever 171 by means of the bolt 170.

In the position of rest the plates 153 rest against pins 172 which are installed on the projections or extensions 56′. On one of the plates 153 there is secured a hooked projection 173 which cooperates with the nose 174′. This nose 174′ is provided on a double armed lever 174 which is mounted on the frame projection 56′ by means of the pivot 175. A bar 177 is pivoted at the free end of the lever 174 by means of the pivot 176 and this bar is held in a guide slot 178 and is provided with a stop 179. A tension spring 180 engaging with the lever 174 and tends to hold the lever 174 in the position shown in Fig. 7 with the stop nose 179 thereby coming into operation.

The lever 171 is mounted on one of the frame plates 56 by means of the pivot 181. By means of the pivot 182 there is secured to the lever 171 a plate 183 which is provided with a rectangular flange 184 which serves as a cam path. The plate 183 is provided with a slot 183′ through which there engages a bolt 185 that is secured to the lever 171. With the bottom end of the plate 183 there engages a tension spring 186, the other end of which is secured at 187 to the lever 171. This spring 186 tends to hold the plate 183 in the position shown in Fig. 7 and the slot 183′ permits the plate 183 to swing out against the pull of the spring 186 in the direction of the arrow in Fig. 7. A roller 188 positioned on the bolt 61 cooperates with the cam path 184.

General operation

The mode of operation can be explained by means of an example in calculation. It is assumed that the following numbers are to be added

7,200
3,175

As the numbers to be added are to be registered simultaneously, the handle 75 must first be set in such a way that it is at the position indicated by S in Fig. 1. By this setting of the hand lever, the boss 72 of the crank 70 is consequently displaced in such a way that the coupling claws 102′ of the spur wheel 102 drop into the recesses 72′ of the boss 72, and the crank 70 is consequently coupled with the spur wheel 102. The lever 77 is simultaneously shifted in the previously described manner and in such a way that the intermediate gearing 87—89 is connected in with the drive so that the main calculating drive shaft 36, when the electric motor is operated, only makes about one third of the rotation made when the drive is direct.

Now 7,200 is set on the keyboard, and this is done by depressing the "7" in the fourth bank of keys from the right and the "2" in the third bank of keys from the right. By depressing the "7" in the fourth bank of keys from the right, the respective levers 15, 16, 17, 17′ are brought into the position shown in dotted lines in Fig. 2. At the same time, by means of the extension 17″ and the bar 42, the respective plate 40 is moved and likewise brought into the position shown in dotted lines in Fig. 2. It must here be noted that the respective rod 22 is displaced by means of the lever arm 17′ in such a way that the corresponding small gear 24 is set opposite that point of the stepped cylinder 32 that has seven teeth.

In this position of the plate 40 (see position in Fig. 4) the third tooth 40^3 will cooperate with the nose 103′. On the movement of the plate 40 into the position as shown in Fig. 4, the pin 46 releases the corresponding lever 45 so that it can take up the position shown in dotted lines in Fig. 2 or the position shown in Fig. 4. The finger-like extension 52 belonging thereto is thereby moved into the range of the angular bend 104′.

The plate 40 belonging to the third bank of keys from the right is moved into the position shown in dotted lines in Fig. 6, so that the step indicated by 40^8 enters into the range of the nose 103′. In this case also the respective lever 45 is released from the pin 46 so that the corresponding finger 52 moves in front of the rectangular stop 104″ of the cooperating plate 104.

All the other levers 45 remain in the initial position because only the two keys mentioned have been depressed.

If now the + key 8 is depressed, then the corresponding lever 140 is moved downwardly with the respective pin 140′ impinging against the cam surface 137′ and the levers 137 and 138 are moved into the position shown in Fig. 9, provided they have not already occupied this position. Furthermore, by means of the rod arrangement 134, the push rod 125 is also set in the position shown in Fig. 9 provided it has not already occupied this position, so that the shoulder 125′ is located in front of the pin 124′.

Through the downward movement of the key lever 140, the electric motor is started by means of a rod connection (not shown in the drawing) in such a way that the main shaft 36 executes

one rotation. During this rotation, the shaft 122 is first of all rocked by means of the push rod 125 and in such a way that the bar 28 couples the bevel gears 26′ in the positive sense with the bevel gears 30 of the totalizer mechanism, whereupon the transfer to the totalizer mechanism takes place by means of the stepped cylinder arrangement 32, so that in the present case the amount 7,200 would appear on termination of the rotation of the main shaft 36.

Simultaneously with the main shaft 36, the crank 70 also makes a rotation being driven by the spur wheels 101 and 102. This permits the double armed lever 62 to execute an upward and downward movement due to the movement of the rod 68.

On the upward movement of the double armed lever 62 the bolt 61 releases all the projections 58 of the bars 54 so that the bars are subjected to the action of the springs 59. These springs now tend to move the bars 54 upwardly as far as possible. On the upward movement of the bars, the projections 58 release the rectangular flanges 104′ that are provided on the levers 104, so that the levers 104 are subjected to the action of the springs 104^6. The levers 104 belonging to the five extreme left banks of keys can thereby move into the extreme left position shown in Fig. 4, so that the noses 104^4 move into the range of movement of the steps or noses 103′ that are mounted on the bars 54.

The bars 54 belonging to the five extreme left banks of keys can accordingly only move upwardly until the noses 103′ on the bars 54 contact the hook-like portions 104^4 on the levers 104.

It must here be pointed out that in Figs. 3 and 5 these five bars are located on the right side because these figures show a rear view. The said five bars are able to move a little upwardly, namely, to such an extent that the blank space 108 that is positioned next to the "O" type is located opposite the platen cylinder 155.

On the other hand, the bar 54 that belongs to the sixth bank of keys can move upwardly into the position shown in Fig. 4, because the lever 104 belonging to this bar is held by the finger 52 in the rearward position shown in Fig. 4. The respective type roller is therefor turned in such a way that the type "7" comes into action when the platen cylinder assumes the position shown in dotted lines in Fig. 4 at the time of printing.

The bar 54 pertaining to the seventh bank of keys can move upwardly until the nose 103′ impinges against the step 40^8 of the corresponding plate 40. The respective bar 54 can accordingly move upwardly as far as shown in Fig. 6. The corresponding type roller thereby setting the type "2" opposite the platen cylinder 155. The lever 104 pertaining to this bar 54 is also prevented from swinging in by the finger 52, so that the nose 103′ can pass by the projection 104^4.

As regards the plates located to the left of the last named plate 104, as seen in Fig. 5, and which belong to the toothed racks or bars 54 of the eighth and ninth banks of keys, these have their oblique flaps 104^3 engaging in back of each other and of the plate of the seventh bank of keys. These two plates are held back in the position shown in Fig. 6 so that their noses 104^4 lie outside the range of movement of the noses 103′ of the corresponding bars 54. This means however that the bars 54 pertaining to the two extreme right banks of keys can move upwardly into the position shown in Fig. 6 in which the noses 103′ contact against the bottom steps 40^{10}. With this position of the bars 54 the two corresponding type rollers are turned to such an extent that the types "0" are set opposite the platen cylinder 155.

On the raising of the double armed lever 62, the individual bars 54 accordingly take up the position shown in Fig. 5, with the types indicated in position. The line A—A in Fig. 5 indicates the line of types that are set opposite the platen cylinder. The type rollers corresponding to the five extreme left banks of keys have a blank type located at the printing point, while there are turned into operating position a "7" from the sixth bank, a "2" from the seventh bank, and a "0" from each of the eighth and ninth banks of keys from the left.

As regards the bar 111 it is to be noted that, as the double armed lever 113 remains in the initial position as shown in Fig. 8, the bar 111 moves upwardly until the nose 112′ engages with the step 113′. This means however that the corresponding type roller 109 sets a blank space opposite the platen cylinder 155. A + sign can also of course be inserted at the corresponding point of the type roller.

Printing operation for first item

On the upward movement of the double armed lever 62, the roller 188 acts against the cam path 184 and the lever 171 is thereby pivoted in the direction of the arrow in Fig. 7. During this pivoting, the spring 169 is tensioned. The platen roller 155 and associated mechanism is, however, prevented by the hooked nose 174′ from joining in the outward pivoting movement. It is only shortly before the double armed lever reaches its topmost end position that one of the lever arms 62 engages with the sliding plate 177 and the lever 174 is thereby pivoted against the pull of the spring 180. The hooked nose 174′ releases the projection 173 and the platen 155 and associated mechanism is moved in the direction of the arrow shown in Fig. 7 toward the type on the type rollers. Thereupon the ink supply cylinder 165 first rolls over and inks the type in the printing position, and the platen cylinder 155 then presses the paper tape 158 against the type.

In the topmost position of the double armed lever 62, the roller 188 passes beyond the range of the cam surface 184, so that the lever 171 is released. The platen and associated mechanism can now drop back under its own weight into the initial position shown in Fig. 7, thereby bringing back the lever 171 into the initial position shown in Fig. 7. On downward movement of the double armed lever 62, the roller 188 rolls upon the inner edge 184′ of the cam surface 184, thereby occasioning a rocking of the plate 183 against the pull of the spring 186. Finally, the roller 188 again releases the plate 183 when the double armed lever 62 has almost reached its bottom end position.

Operation for addition of second item

After the amount 7,200 has been transferred in this way into the totalizing mechanism and also onto the paper tape 158, the next number to be added 3,175 is introduced into the keyboard. By depressing the corresponding keys, the respective plates 40 are given the corresponding settings by the rods 42, so that on depressing the addition key 8 it is transferred on to the paper tape at the same time that it is transferred into the totalizing mechanism.

The result 10,375 that now appears in the totalizing mechanism is now transferred into the

keyboard and this can be done, if necessary, by any of the known back transfer devices.

Transfer of result

Hereupon the hand lever 147 is brought into the position shown in dotted lines in Fig. 8 so that the double armed lever 113 coupled thereto takes up the position shown in dotted lines in Fig. 8. Now the — key 9 is manipulated in order to clear the amount from the totalizing mechanism simultaneously with the transfer of the result on to the paper tape.

When the — key 9 is depressed, the pin 141′ engages with the cam surface 138′ when the respective key lever 141 moves downwardly and the levers 137, 138 are thereby pivoted to the right from the position shown in Fig. 9. This results in a pivoting of the push rod 125 which, in the pushing movement, will displace the bevel gear supports 26 in the negative sense, so that the bevel gears 26″ engage with the bevel gears 30 of the totalizer mechanism. For setting the electric motor into operation there is the same mechanism for the — key as for the + key.

On the rotation of the main shaft 36 that is thereby produced, the amount appearing in the totalizer mechanism is again transferred in the negative sense from the keyboard, and this results in clearance. The corresponding setting of the type rollers takes place at the same time, so that the result is printed on the paper tape during the oscillating movement of the platen cylinder.

As the double armed lever 113 has been brought as above mentioned into the dotted line position shown in Fig. 8, the cooperating bar 111 can move upwardly on upward movement of the double armed lever 62 until the nose 112′ contacts the step 113^3. This however results in the respective type roller being turned so that the = sign is set opposite the platen cylinder. The = sign consequently appears for the result transferred to the paper tape, so that the calculation as transferred to the paper tape looks like this:

7 200
3 175
10 375=

In order that the hand lever 147 may not have to be specially brought back to the initial position when there are further addition calculations to be made, the lever 145 is provided with a rectangular flange 145″ that extends into the path of oscillation of the lever 171. When, on upward movement of the double armed lever 62, the lever 171 is pivoted to the left as shown in Fig. 7, it impinges against the extension 145″ at the end of this movement and presses the lever into the initial position as shown in Fig. 7 and the spring actuated nose 150 thereby snaps into the socket 149. The pin 144 is also released together with the lever 113, so that the lever is now subjected to the action of the spring 115. As soon as the bar 111 is again moved into the initial position on the return movement of the double armed lever 62 into its initial position, the nose 112′ releases the bottom part of the lever 113 so that this can now swing back into the initial position as shown in Fig. 8.

Registering subtraction items

In order to make any—items of an addition calculation perceptible on the paper tape, the device 116—121 is provided. On manipulation of the shift bar 28 in the subtractive sense, i. e. on its displacement to the left as shown in Fig. 9, the double armed lever 113 is adjusted by the lever 121 and the rod 116 in such a way that the step 113″ is brought into the range of movement of the nose 112′. On the upward movement of the double armed lever 62, the bar 111 can move upwardly until the nose 112′ impinges against the step 113″. In this case, the corresponding type roller 109 is moved so that the type provided with the — sign comes in front of the platen cylinder 155. If, for example, 888 has been deducted in a calculation, this is registered on the paper tape as follows:

888—

It must also be noted that, instead of the type rollers provided, the type can also be installed direct on the bars 54, as indicated in Fig. 11. In this case, the platen and associated mechanism would accordingly cooperate directly with the bars 54 which carry the type "0"–"9".

In the embodiment shown in the drawings, the type rollers used have twelve spaces. It is, of course, sufficient to make the type rollers with eleven spaces, in which case the one blank type would have to take up the initial position indicated in Fig. 2 by *a*. Of course the tooth relation between the racks 54 and the spur wheels 105 would have to be arranged in such a way that when, for example, the nose 103′ impinges against the top step 40′ of the plate 40, the respective type roller sets the type "9" opposite the platen cylinder.

Release of registering mechanism

If calculations are to be made on the machine without the keyed amounts being transferred simultaneously to the registering or printing device, then it is only necessary to move the hand lever 75 to the left until it comes in front of the letter R. The intermediate gearing 87—89 is thereby disconnected and the electric motor is coupled to drive the drive shaft 36 of the calculating machine more rapidly. The coupling 72′, 102′ is also released at the same time, so that the crank 70 remains in the position of rest during the rotations of the main calculating shaft 36.

Damping mechanism

In order to compensate to some extent the irregular loads of the machine drive occasioned by the long double armed lever 62, there is provided an air damper which consists of a cylinder 189. This cylinder is pivotally positioned on the machine frame at 190. In this cylinder there is installed the piston 191 whose piston rod 192 is pivoted at 193 to a lever 194. The lever 194 is positioned on the shaft 66 that is located in the machine frame. The space located in front of the piston is controlled by an adjustable valve 195. On the movement of the piston rod 192 to the left, as seen in Fig. 2, which takes place on the lifting of the double armed lever 62, the piston moves freely. On the downward movement of the double armed lever 62, which causes a movement of the piston rod 192 to the right, however, the air cushion in front of the piston comes into action and it is possible to adjust the outlet valve 195 according to the amount of damping desired.

Registration of multiplication or division calculations

Of course multiplication or division calculations may also be registered or recorded with the new device.

In this case, one may proceed as follows:

First, the multiplier is set in the keyboard and is registered by manipulation of the + key. Hereupon the multiplicand is also likewise set in the keyboard and likewise set down on paper by manipulation of the + key. Thereupon the hand lever **75** is shifted to R while the set multiplicand remains in the keyboard. After the totalizing and revolutions counter mechanisms have been cleared, the set multiplicand can be multiplied by the previously written down amount of the multiplier by corresponding manipulation of the + key. The result that appears in the totalizing mechanism is transferred to the keyboard and likewise set down on paper in the already described manner.

In order to properly distinguish the individual amounts, it is in this case advisable to provide the type roller **109** with an addition "*x*" type which is associated with the multiplier by insertion of a special setting device.

In the embodiment shown as an example, the arrangement is devised in such a way that one can both calculate and also calculate and register. By suitable designing of the shift lever **75** and suitable designing of the couplings, etc., there is also of course provided a third possibility of adjustment by which the amount set in the keyboard is only registered.

ULRICH EICHLER.

PUBLISHED
MAY 25, 1943.
BY A. P. C.

U. EICHLER
CALCULATING AND REGISTERING MACHINE
Filed Nov. 2, 1937

Serial No.
172,446
8 Sheets-Sheet 1

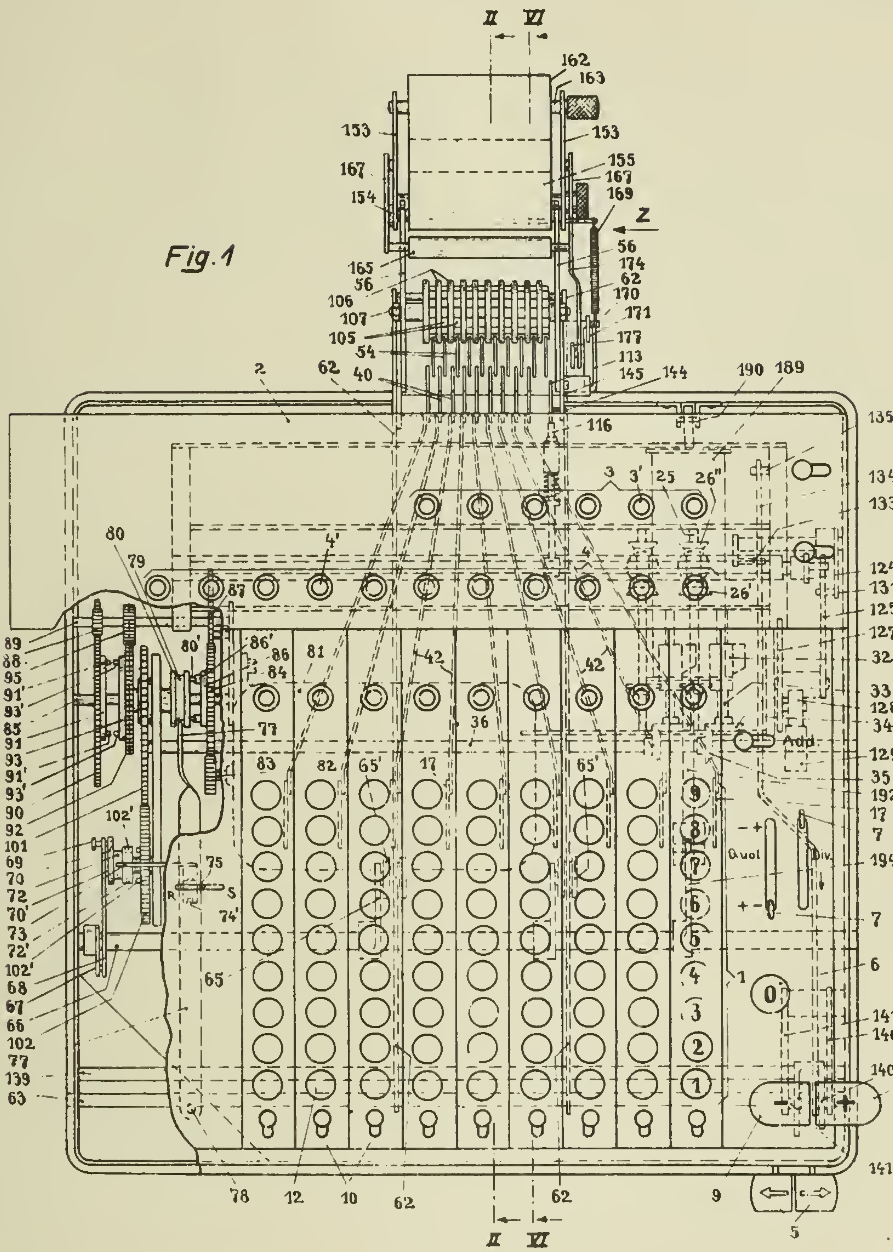

Fig. 1

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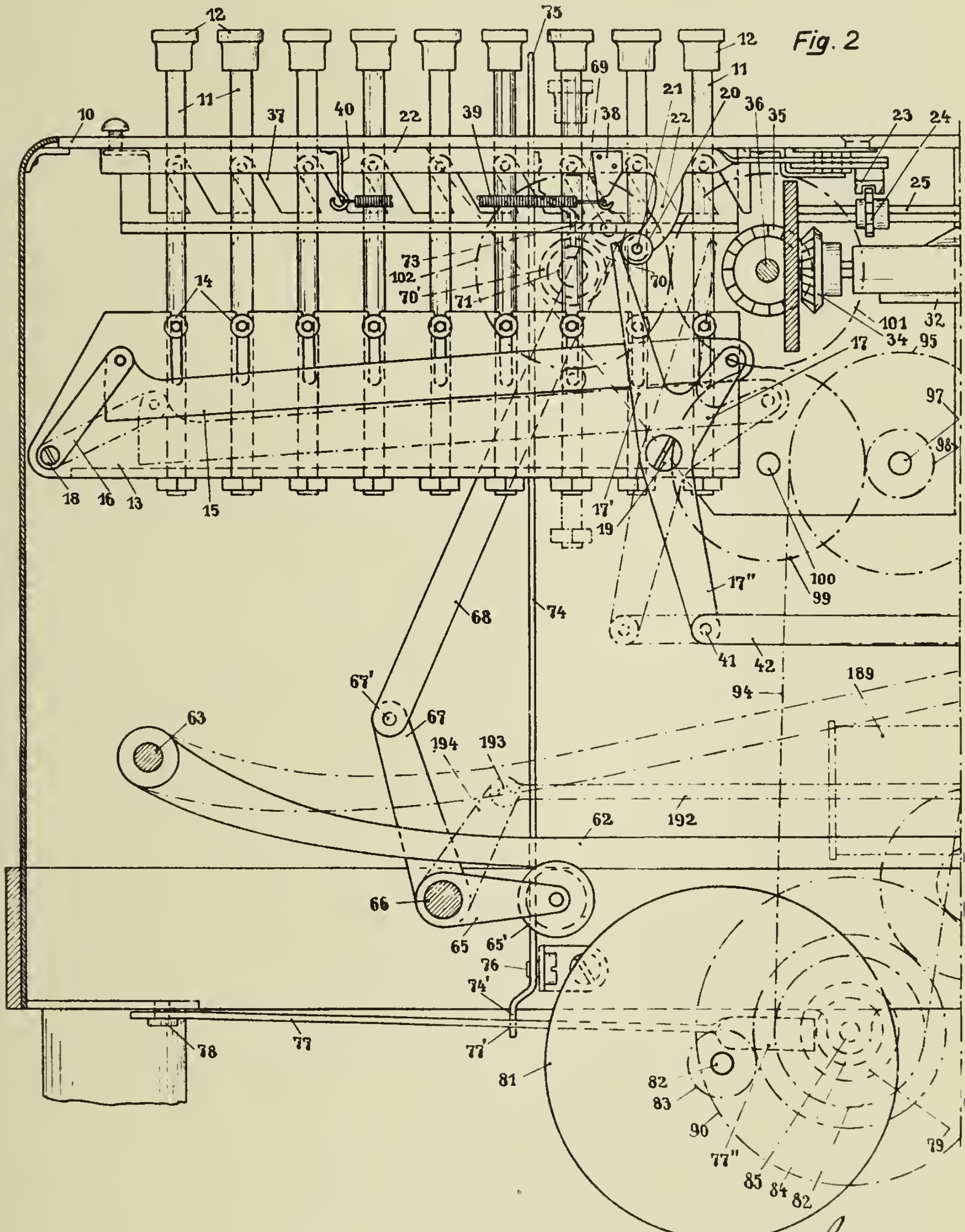
Fig. 2



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Serial No.
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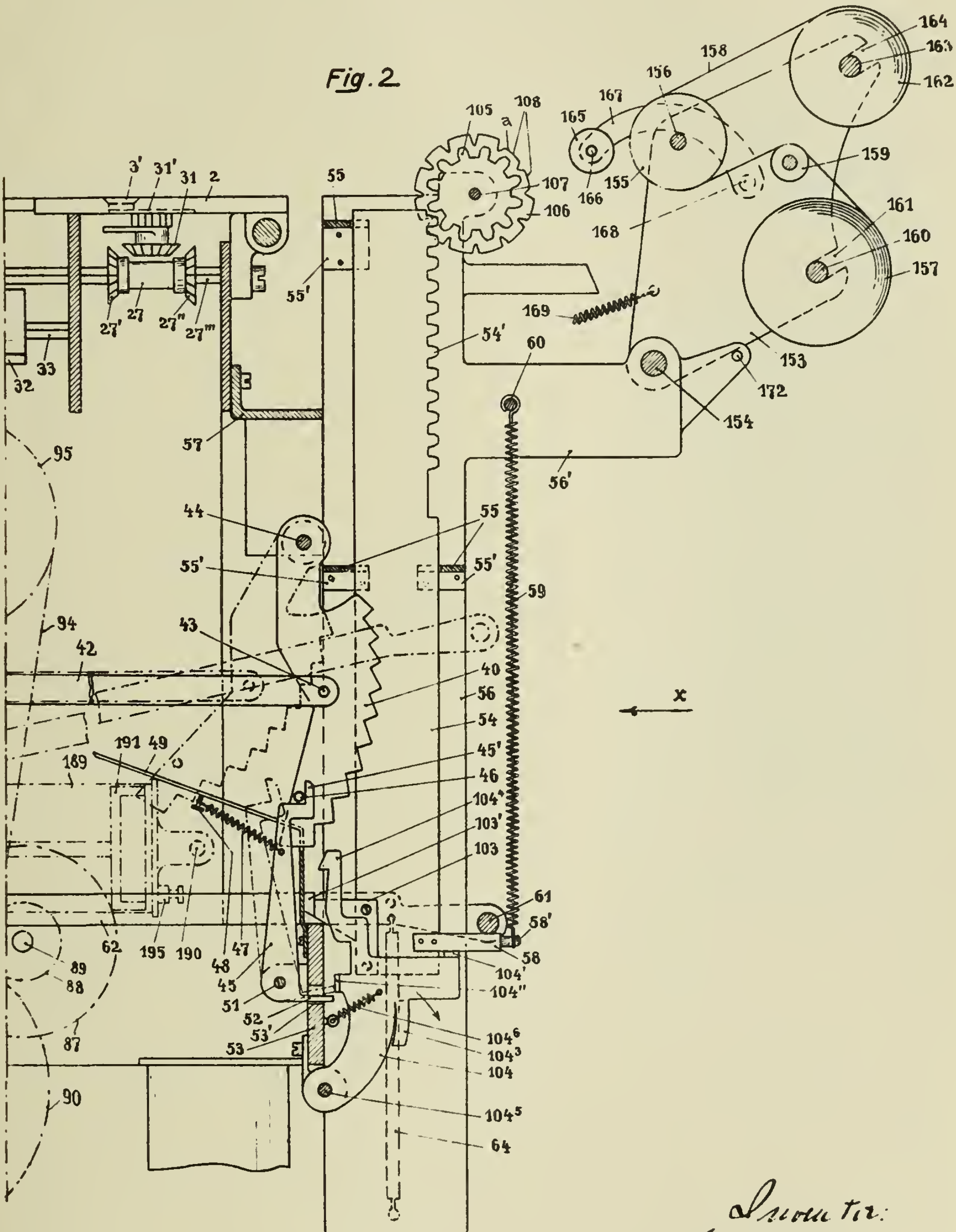
Fig. 2



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Serial No.
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8 Sheets-Sheet 4

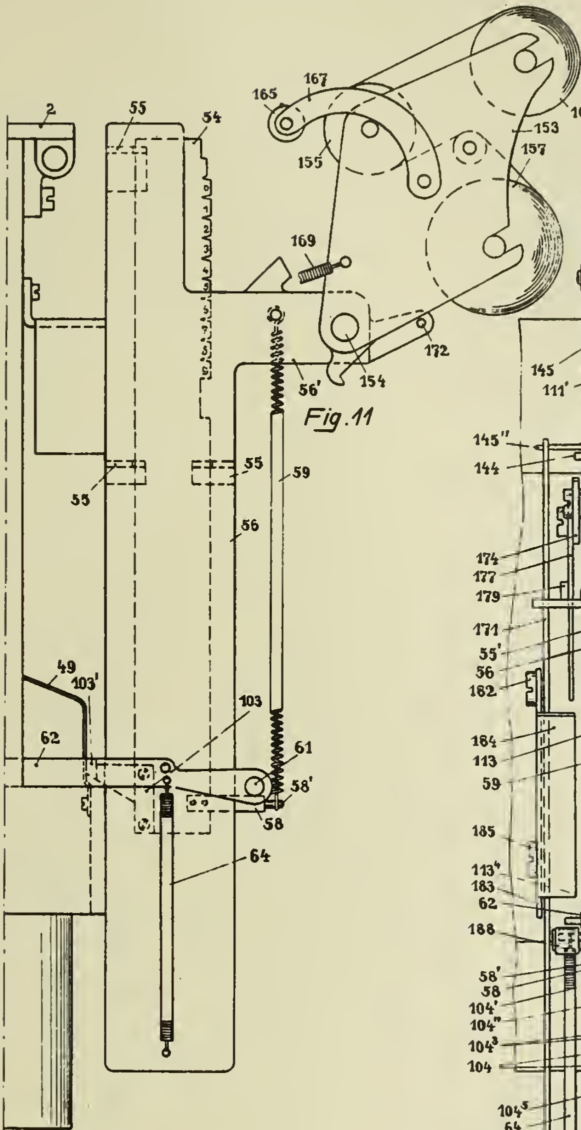

Fig. 11

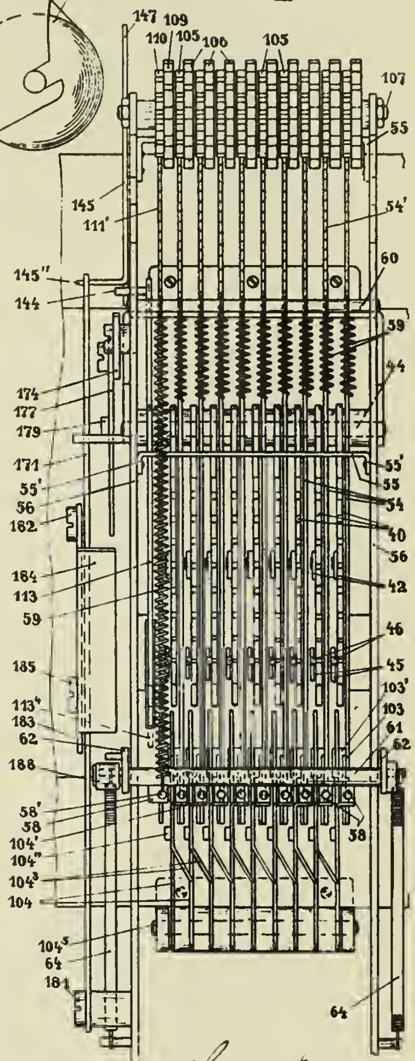

Fig. 3

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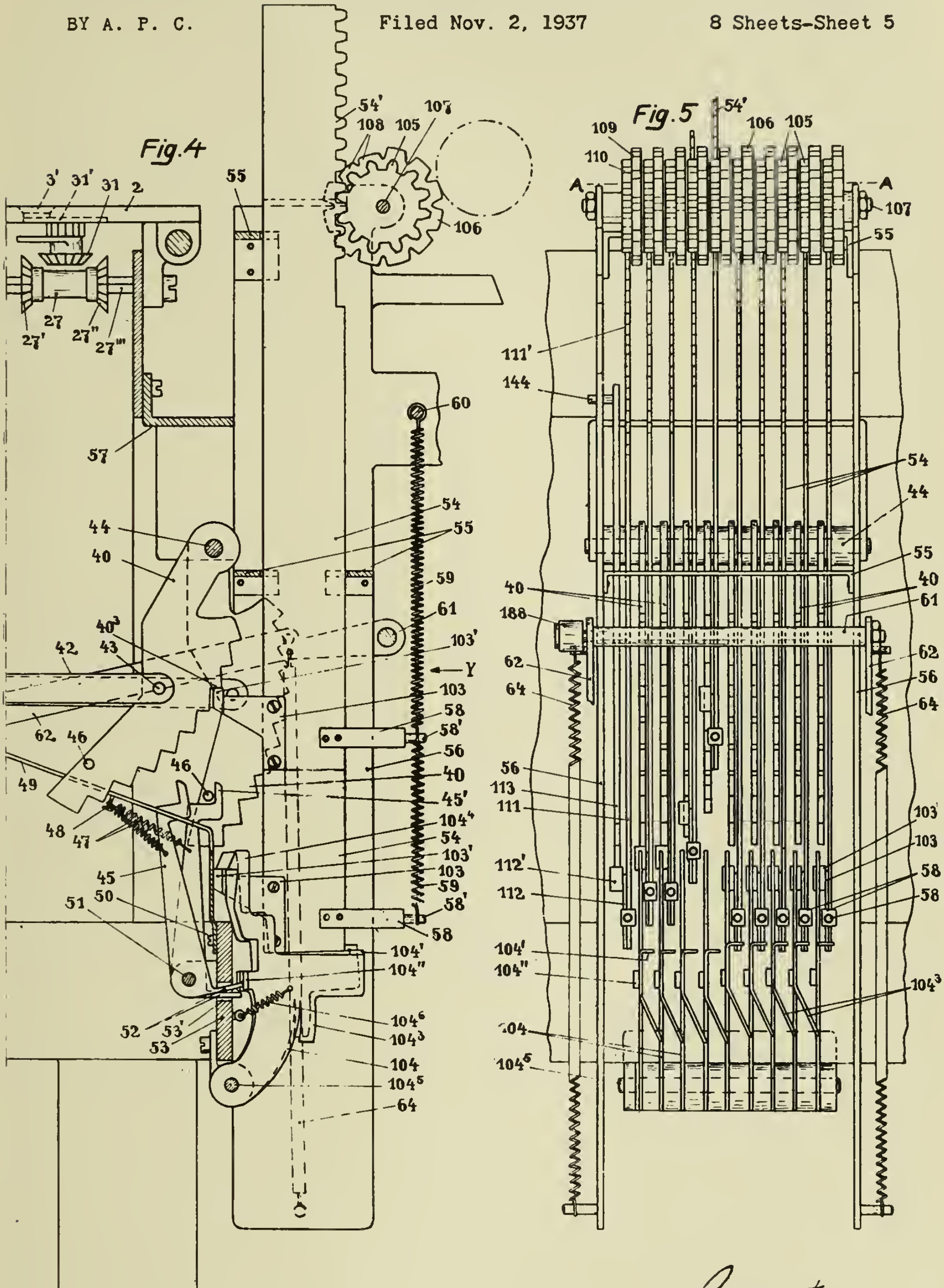
MAY 25, 1943. | CALCULATING AND REGISTERING MACHINE | 172,446
BY A. P. C. | Filed Nov. 2, 1937 | 8 Sheets-Sheet 5



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CALCULATING AND REGISTERING MACHINE
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Fig. 8

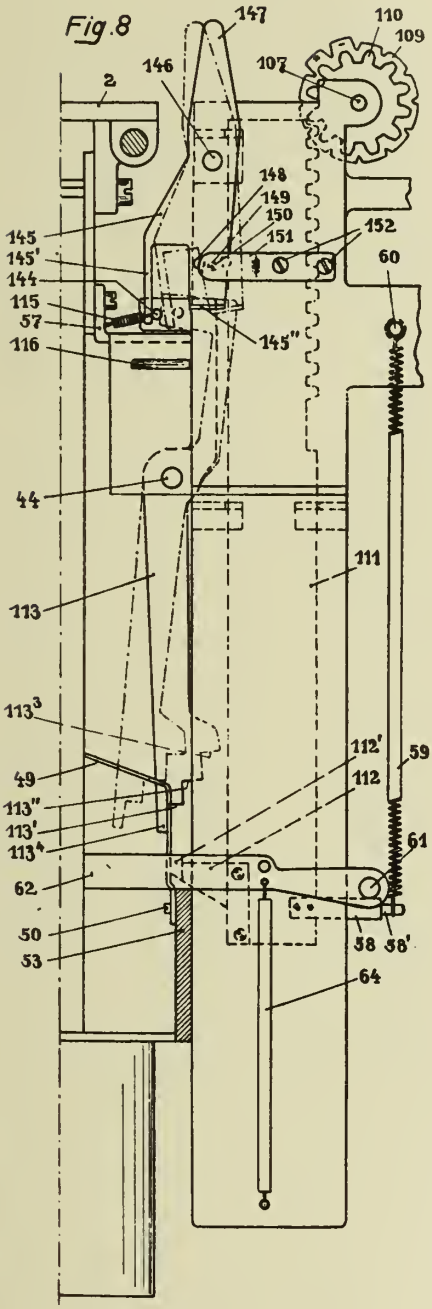

Fig. 6

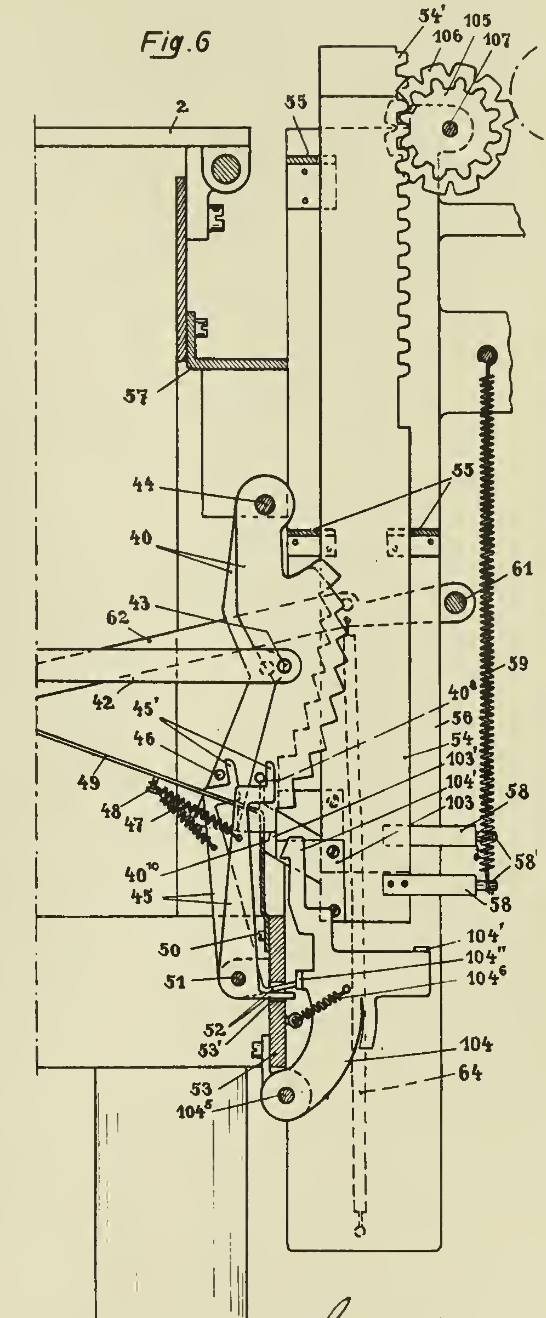

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Fig. 7

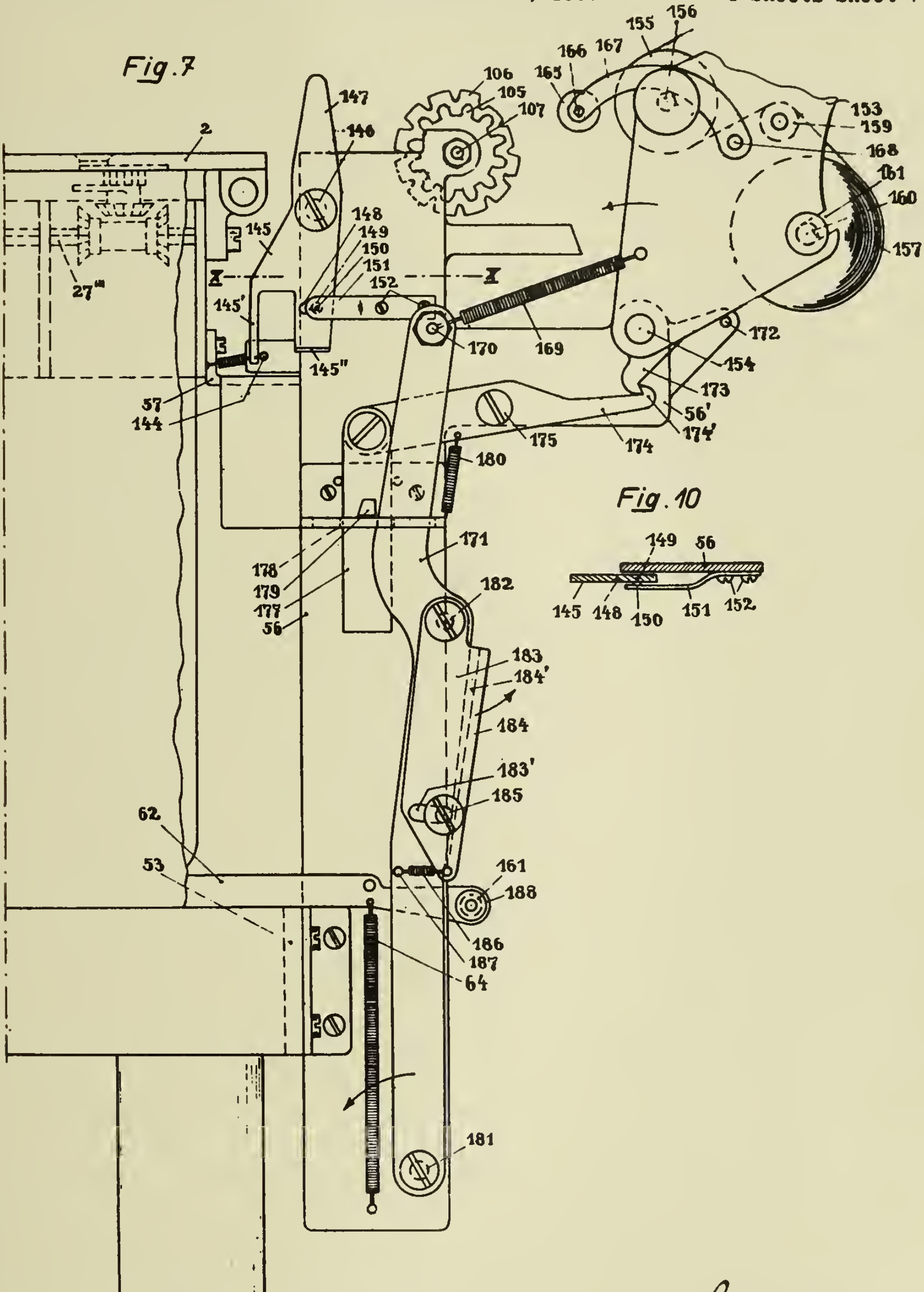

Fig. 10

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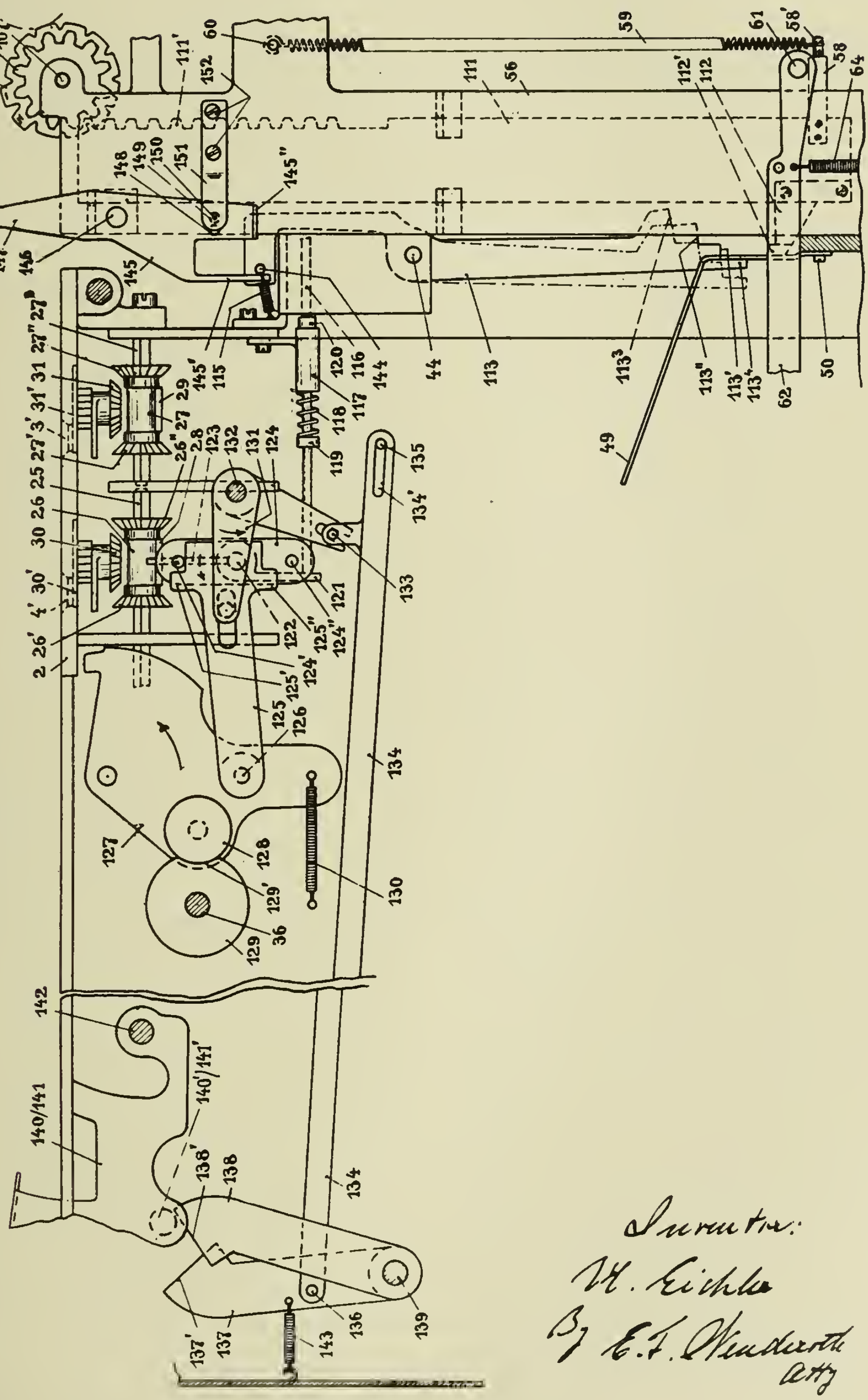

Fig. 9

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ALIEN PROPERTY CUSTODIAN

SELECTIVITY APPARATUS

Ladislas de Kramolin, Berlin-Kladow, Germany; vested in the Alien Property Custodian

Application filed December 22, 1937

The present invention relates to selectivity arrangements for oscillatory circuits and particularly for radio receiving and transmitting circuits.

In general, the selective qualities of a set which are obtainable with oscillatory circuits are dependent upon the determinative portions of these circuits alone, so that normally it is not possible to obtain with tuning circuits which are composed of given capacities and inductances, and with the losses peculiar to these determinative portions, a greater separating sharpness than approximately corresponds to the half-value width (Halbwertsbreite) of such a circuit, the separating sharpness being intended to mean here the interval between two channels to be separated.

If, therefore, the half-value width of an oscillatory circuit amounts to 10 kilocycles, it is therefore not possible to obtain the result, by any desired number of such circuits in an arrangement, that it allows of separating channels from one another, the interval of which is less than 10 kilocycles.

According to the present invention, use is made of counter-coupling or negative feed-back channels in amplifying arrangements, which counter-coupling channels contain filter means dependent upon frequency, that is, for instance, oscillatory circuits or combinations of such oscillatory circuits (band filters or limiting filters or the like), whereby selective structures can be produced which are not subject to the above limitations.

The circuits inserted in the counter-coupling channels may be series or parallel resonant circuits or combinations of both types, and the counter-coupling channels may either lie in the anode circuits or equivalent circuits themselves, in which they are arranged either in the anode or cathode supply leads of the amplifier units, or they may lie in the supply leads to individual or several control or auxiliary electrodes, the essential fact always residing in that they serve as means for obtaining a selective counter-coupling.

In order that the invention may be more clearly understood, various embodiments will be described with reference to the accompanying drawings.

If an amplifier according to Fig. 1 is constructed, for instance, with a pentode **50** in the well-known connection with a tuned anode circuit **54**, and if at first the constructional elements in the cathode lead, namely, the inductances **51**, the choke **52** and the condenser **53** are imagined to be replaced by a normal variable resistance, the following can be observed:—

No consideration will be given in the first place to the production of the grid bias for the input grid, but it is assumed that, by means of a constant favourable grid bias produced in some manner, the valve operates on the steepest part of the characteristic which can be controlled by the input voltage to be amplified. If, now, the resistance imagined in the cathode lead is given the value zero, the highest amplification is given by the other determining portions of the circuit. If the resistance is slowly increased, commencing from zero, a diagram results which is illustrated in an approximate manner in Fig. 2. In this curve the value x represents the particular amplification which corresponds to a resistance value y of the variable resistance imagined in the cathode lead. The curve shows that, on gradually increasing the resistance, the amplification decreases, since, of course, with increasing resistance, the counter-voltage becoming effective at the input grid of the tube continuously increases. The input circuit of the tube, which is inserted at the place indicated by the arrow between the grid supply lead and negative pole may, in this case, be constructed in any desired way: It may be a question of a coupling coil which is substantially aperiodic for the frequencies to be amplified, a transformer tuned to the frequencies to be amplified, or an ohmic resistance or the like.

As the curve in Fig. 2 shows, at a certain limiting value of y, x has become equal to zero, that is, even with a further increase of y no further substantial change takes place in the arrangement. The actual operations probably show small deviations from the curve shown due to stray capacities, since however, especially with tubes having a high amplification factor and great steepness, only small resonance values suffice to obtain in the curve the value of y indicated by the chain-dotted section line, the parallel capacities do not falsify the conditions set forth, to any great extent.

Therefore, the law exists that amplification occurs below a certain value of y, but no further amplification occurs above a certain value of y.

The network formed by the constructional elements **51**, **52** and **53** now corresponds to a series resonant circuit, since the choke coil **52** connected in parallel with the condenser **53** is to have such a high inductance that it acts merely as a capacitive resistance for the frequencies to be considered here, while, on the other hand, it al-

lows the anode direct current necessary for the working of the tube to reach the cathode.

Curve C in Fig. 3 shows the resistance of the combination 51, 52, 53 which is effective at different frequencies, the abscissae indicating wave-lengths and the ordinates resistances.

Commencing from small wave-length values, the combination has a certain, rather considerable reactance of capacitive nature. On approaching the resonance frequency, the capacitive resistance gradually falls until reaching the resonance frequency. At this resonance frequency, the capacitive resistance has completely disappeared and the arrangement has a minimum effective resistance. On further increase of the wave-length, the effective resistance of the combination increases again, in which case at increasing wave-length it now has an inductive character.

For the consideration to be undertaken here in the first instance, it is not important whether the resistance is purely ohmic capacitive or inductive, but only the potential drop occurring due to the resistance is of interest. If we now consider the curve *c* in Fig. 3, it is found, as was not otherwise to be expected, that it is a question here substantially of an inversely recorded resonance curve, the resonance sharpness, that is, the obtainable flank steepness, half-value width etc. being given by the loss resistance of the circuits employed, in other words, by the circuit quality. Therefore, under normal conditions, only a definite selectively determined by the half-value width of the resonance curve can be obtained with these given constructional elements.

This is important, in particular, in short-wave sets and, therefore, also in superheterodyne receivers with a short-wave intermediate frequency part, since if, for example, owing to the obtainable circuit quality at a definite frequency, a half-value width of 15 kilocycles is given, even no greater selectivity can be obtained by series connection of any desired number of such circuits in amplifiers and the like that is, for instance, no stations can be separated which have a mutual frequency interval of 10 kilocycles.

If, however, the determinative portions of the circuit, on the one hand, and the determinative portions of a tube arrangement according to Fig. 1 are so chosen that the limiting value of the resistance *y* as represented in Fig. 2 by the chain-dotted line is illustrated by the chain-dotted line *d* as entered in Fig. 3, the following results; since an amplification, of course, only occurs at all if the resistance in the cathode circuit is, for instance, less than the value *d*, then on passing through the wave-length spectrum (see Fig. 3) no amplification occurs at all if, commencing at the minimum wave length, advancement is made up to the value λ_1. Only commencing from the value λ_1 does amplification begin, which increases, reaches its maximum amount at the resonance value of the circuit, and then falls again until the wave length λ_2 is reached, whereas after exceeding this wave-length value, all amplification again ceases.

Whereas there is obtained by the determinative portions of the circuit a resonance curve which has a half-value width *f*, the width of the whole range, within which an amplification takes place, is characterised only by the wave-range *g* in Fig. 3.

It is therefore seen that by this means it is possible, with the aid of a circuit which in itself would not render possible any separation of transmitters of a certain frequency interval, even in the case of several cascade circuits, to construct an amplifier which has a greater separating sharpness.

Since, especially at high frequencies, stray capacities may introduce errors, it is important to work with tubes having a relatively high "Durchgriff" and high steepness. On the other hand, it is also desirable that the tubes shall have a high internal resistance, in order that even with good tuning circuits, 54 in the anode circuit of the arrangement (Fig. 1), no excessive current intensity drop occurs near the resonance position.

For the production of the effect just described, exponential tubes may also be employed, but it may be very desirable to use tubes which have a sharp lower bend in their characteristic, for which reason preferably indirectly-heated tubes are employed in such cases. It is also desirable in these cases to use cathodes of the smallest possible emission work, or other cathodes, in which as small as possible a control of the Maxwell speed distribution is existent.

In order to make the current drop in the tube small and thus also the effective counter-coupling at the input grid in the case of anode circuit coupling to the next amplifying stage or other circuits, it may also be desirable to connect ohmic resistances in series with the circuit 54. Of course, when coupling subsequent circuits, however, no restriction is made to the tuned anode circuit coupling, but, for coupling, tuned or non-tuned transformers and all other possibilities of coupling well-known per se of periodic or aperiodic nature may be employed.

Instead of a simple series resonant circuit after the fashion of Fig. 1, there may also be inserted in the cathode lead a plurality of circuits or networks, filters or the like, which produce a larger number of channels due to the effects illustrated by Figs. 2 and 3, or, alternatively, band or limiting filters may be used in the cathode supply lead, whereby the frequency ranges approximately determined by these filters then undergo a sharper separation than by the filter means alone.

The arrangement therefore serves quite generally to increase the flank steepness and to increase the obtainable selectivity with any frequency-differentiating or any other filter means.

Instead of working at the lower bend, it is also possible to work at the upper bend of an amplifying arragenment; instead of tubes, any other amplifiers may be used accordingly.

Similarly as by the use of series resonances in the cathode circuit the conditions set forth are produced, it may be desirable for obtaining complementary conditions to provide parallel resonant circuits in the cathode lead, in which case, when working at the lower or upper bend, corresponding phenomena result.

Selective conditions with regard to frequency and amplitudes may also be produced if the work is done within a limited range between the lower and upper bend, which will then be over-controlled on exceeding certain amplitudes.

A further possibility of use of the arrangement described with reference to Figs. 2 and 3 resides also in the following. It is known particularly in normal three-electrode tubes that it is difficult to obtain, say, in a receiving circuit designed with the assistance of the well-known Huth-Kuhn oscillating circuit, an approximately con-

stant back-coupling in internal capacity or an auxiliary capacity connected in parallel therewith, over a large frequency range. Since, in the curve diagram of Fig. 3, the effective resistances towards one side are capacitive and towards the other side are inductive, then by such an arrangement of tuning means in the cathode circuit, frequency dependencies of the anode circuit can be compensated upon adequate arrangement and, thus, constant back-coupling effects can be obtained.

Further modifications of the invention are shown in Figs. 4–8.

Fig. 4 shows an arrangement in which **1** is the input transformer of a pentode **2**. The amplified output arises in the tuned anode circuit **3**. In the cathode supply lead, a resistance **4** is inserted, from which the grid bias for the control grid **7** can be derived through a slider **5** and decoupling resistance **6**.

For the oscillations reaching the control grid **7** through the transformer **1**, the resistance **4** constitutes a counter-coupling arrangement. By this means, therefore, in contradistinction to a back-coupling, amplification-reducing voltages are introduced.

An exception exists only for such oscillations to which the series resonant circuit **8**, **9** is tuned, since for these oscillations the resistance **4** is practically short-circuited.

By tuning the circuit **3**, on the one hand, and the circuit **8**, **9**, on the other to a certain receiving frequency, the result can be obtained that, independently of possible selection means which are already existent in the grid circuit of the tube **2**, an increased tuning sharpness arises as compared with an arrangement in which only a tuned anode circuit is provided.

This increased tuning sharpness is not only attributable to the fact that, in addition to the tuning means of the circuit **3**, still further means are provided in the anode circuit, but owing to the use of the series resonant circuit in the cathode supply, an increase of selectivity going beyond this pure total effect occurs.

This, as well as the sensitivity of the arrangement can be considerably increased if a regulatable back-coupling is introduced, which can be obtained in a simple manner, for example, by applying a variable voltage to the grid **2** by means of a further slider **10**. The more the slider **10** approaches the cathode, the stronger the back-coupling becomes. In this manner, a very sensitive adjustment of the arrangement can be found.

With a permanently adjusted back-coupling, the selectivity and sensitivity of the arrangement can also be increased still further by repeated re-tuning of the circuits **3**, on the one hand, and **8**, **9**, on the other.

This appears to be attributable to the fact that by small variations of the condenser **8** the phase position existing in the anode circuit is varied and thus the arrangement can be adjusted to most favourable conditions.

Since very slight variations of the capacity **8** are already accompanied by very material alterations of the selectivity and sensitivity, a variation in the series resonant circuit **8**, **9** or a displacement of the slider **10** in any apparatus, particularly in a receiving set, may also be used for selectivity or sensitivity regulation.

On manual adjustment, in this case, the three variables, namely, the resistance **10**, the inductance **9** or the condenser **8** may be operated.

The arrangement appears to have a substantially greater importance, however, for an automatic sensitivity or selectivity regulation, since, as has been mentioned, small variations in this circuit already produce considerable effects, so that, with the aid of small control voltages, by means of control tubes, by means of condensers dependent upon voltage (for instance, piezo-electric arrangements) or by means of inductances dependent upon voltage or current (e. g. premagnetising arrangements of iron-containing coils) the required small variations of the capacity, inductance or resistance in this circuit can be produced.

In this case, several arrangements according to Fig. 4 may be combined in a cascade amplifier, which also applies to the arrangements to be further described.

It is precisely in highly-selective sets that this arrangement may be of importance because it allows of obtaining very high selectivity figures with a relatively small number of tubes without large amplification losses.

If, in a normally tuned cascade amplifier, two tubes are coupled together, then normally two tuned circuits are provided, namely, a tuned anode circuit, which is connected to the anode of a preceding tube and a tuned grid circuit, which is connected to the grid of the next succeeding tube.

Apart from the cases in which this arrangement serves to obtain a resonance curve flattened at the top, which, moreover, can be obtained by suitable determination of the dimensions also in an arrangement according to Fig. 4, such devices mainly have the purpose of increasing the selectivity by the use of two circuits instead of an ordinary anode circuit coupling.

This selectivity increase, however, is obtained at the cost of a very considerable amplification loss, since even with optimum coupling of the two circuits, of course, only 50% of the voltage can be transferred to the grid of the succeeding amplifying tube, which would otherwise be existent in the case of ordinary coupling of two successive amplifier stages by a single tuned anode circuit.

If, however, the procedure according to Fig. 4 is adopted, the lead **11** may be directly connected to the grid of the next succeeding tube, so that, therefore, the full amplification is existent as in the case of a normal coupling by tuned anode circuits, but nevertheless owing to the two existing tuning circuits between the tube **2** and the succeeding amplifying tube, namely, owing to the circuit **3**, on the one hand, and the circuit **8**, **9**, on the other, not only the selectivity otherwise obtainable with two circuits exists, but an even higher separating sharpness.

Therefore, in this way, desired selectivities can be obtained without the amplification losses occurring with the ordinary use of coupled circuits, in which case, of course, the arrangement described here may be combined with the use well-known per se of coupled circuits, that is, special tuned circuits in the grid circuits.

It is precisely in the superheterodyne receivers frequently employed at the present day, having a very small number of amplifying tubes, that the arrangement described is advantageous, since it is not necessary to increase the number of tubes in order to be able to increase the number of oscillatory circuits employed, and greater selectivity without amplification loss can be obtained in the case of an equal number of tubes.

A three-tube superheterodyne set would, for instance, be constructed substantially as follows according to present-day principles: The anode circuit of the mixing tube would be tuned to the intermediate frequency and coupled to a further tuned oscillatory circuit, which is connected to the grid of the succeeding intermediate-frequency pentode. The anode circuit of this pentode is also tuned and transfers a voltage to a diode with a succeeding loud-speaker tube. Therefore, altogether three intermediate-frequency circuits are provided.

With the same tube equipment the set can be constructed on the basis of the present application as follows. The mixing tube receives a tuned anode circuit as well as a series resonant circuit in the cathode lead, which circuit is tuned to the intermediate frequency. The tuned anode circuit is coupled to a tuned input grid circuit, which is connected to the intermediate-frequency pentode. This intermediate-frequency pentode has again a tuned anode circuit and a series resonant circuit in the cathode lead. However, let the set be unaltered. With the same number of tubes, five tuned circuits are then provided instead of three tuned circuits, without having to involve the additional amplification losses when using further coupled circuits.

In addition, the series circuit existing in the cathode circuit supply lead of the mixing tube acts for all frequencies which do not correspond to the intermediate frequency as a negative back-coupling in linearising manner, so that the purpose of the multiplicative mixing often employed at the present day can be achieved to an increased extent in the mixing tube. Moreover, the series resonant circuit in the cathode supply lead of the high-frequency pentode, owing to introduction of a certain degree of back-coupling, allows of removing the damping of the anode circuit of this tube, so that the damping caused by the diode path in this circuit can be eliminated, so that this circuit also provides a high selectivity and sensitivity.

If it is desired to obtain band filter effects, that is, for instance, resonance curves which have at the apex a depression or a rectangular flattening, this can be produced by corresponding adjustment of the values of 8, 9 and 10 or equivalent measures (for instance in arrangements where the counter-coupling is obtained not by a resistance **10** but by capacitive or inductive counter-coupling means well-known per se).

A depression in the resonance curve arises entirely by itself if the dynamic resistance of the circuit **3** becomes so great that it is no longer negligible as compared with the internal resistance of the tube **2**.

By the use of tubes which, during operation, permit a variation of their alternating current resistance, it is easily possible in this way to alter the resonance curve form and thus to introduce a variable selectivity.

Since such a variation of the tube resistance, for instance in tubes which are constructed as exponential tubes, is possible by mere bias variation at the control grid or any auxiliary grid, this method is also particularly suitable for automatic selectivity or other regulating arrangements. In particular, this applies to multi-stage arrangements.

As has already been set forth above, by small successive after-regulation of the condenser in the circuit **3** and of the condenser **2**, and possibly also of the slider **10**, the sensitivity and separating sharpness of an arrangement according to Fig. 4 can be made extremely high. Finally, however, there is, of course, a limit at which the arrangement then goes into self-oscillation.

Shortly before reaching this limit, the arrangement is still very stable with regard to voltage fluctuations of the tube feeding currents, but relatively low high-frequency voltages as well as sudden current impulses in any lead situated in the vicinity cause a commencement of natural oscillations.

For example, the anode voltage of the arrangement can be increased by 100% by gradual upward regulation, without the arrangement commencing to oscillate, whereas a cutting-in and out of an incandescent lamp provided at the experimental table can effect the initiation of natural oscillations, evidently by impulsive excitation of the tuned oscillatory circuits.

This sensitivity of the arrangement brought to a highly-sensitive condition, in relation to substantially excessive high-frequency voltages, can be considerably reduced if an exponential tube is employed as the amplifying tube.

Since, as is shown in Fig. 4, a variable back-coupling can be introduced by a tapping **10** at the resistance **4** and this back-coupling, particularly if the resistance **4** is not bridged over by a series circuit **8**, **9**, is independent of frequency to a great extent, such an arrangement may also be employed after the fashion of a multi-vibrator. In such a case, it may then be preferable to interchange the function of the input grid **7** and of the collecting grid **2** or to take care in some other manner that the voltage derived by the slider **10** reaches a grid with greater steepness than the steepness acting at the input grid.

Instead of a single grid connected to the resistance **4** (collecting grid in Fig. 4), several grids may also be connected by means of regulatable sliders or otherwise to this resistance, so that negative and positive back-coupling voltages are supplied to them.

By difference or sum effects between such different grids which are adjustable preferably in voltage amplitude by means of sliders or the like, quite high sensitivities can be obtained, since the tube can be brought to quite an unstable condition by successive after-regulation of these different grid voltages. The different grids in this case must not be at the cathode direct current potential, but the direct current bias of the grids may be adjusted independently of its alternating current voltage by the use of coupling resistances and condensers, as is shown for the collecting grid of Fig. 5.

For perfectly aperiodic back-couplings, aperiodically-acting resistances are preferably used also in the anode circuit and possibly in the input circuit.

While, in an arrangement according to Fig. 4, the back-coupling may be devised in such a manner that it has an amplifying effect on different frequencies, which may be advantageous, for instance, in a mixing tube for superheterodyne receivers, particularly when using aperiodic input circuits, it may be desired for other cases not to derive the back-coupling from an aperiodically-acting member, such as the resistance **4**, but, on the contrary, to limit the back-coupling action only to a desired frequency or a desired frequency band.

Such an arrangement is diagrammatically illustrated in Fig. 5. Since the series resonant circuit **8**, **9** has a small resistance only for the os-

cillations to which it is tuned, it is clear that a back-coupling which is effective between the series resonant circuit **8**, **9** and the tuned anode circuit **3** will be effective only for the natural frequency of these circuits. It increases the selectivity further and increases the sensitivity for the tuning frequencies. The back-coupling, in this case, may be effected both inductively and capacitively.

In Fig. 5, an inductive back-coupling is illustrated by the curved arrow **12**. Whereas, as described in the arrangements corresponding to Fig. 4, maximum sensitivities can be obtained by successive re-tuning of the circuits **3** or **8**, **9**, arrangements according to Fig. 5 and similar thereto (that is, in particular, those which work with tuned back-coupling) are extremely stable in tuning at all occurring degrees of coupling between the coil **9** and circuit **3**. In this case, extremely high selectivities can be obtained at somewhat reduced sensitivity.

Since the collecting grid **2**, if it is directly connected to the cathode can cause, with adequate collecting-grid steepness, such a strong back-coupling that the tube **3** oscillates, it may be preferable to introduce an additional counter-coupling for the back-coupling adjustment between the coil **9** and the inductance of **3**.

In addition, however, the collecting grid **2** may also be directly led to the negative pole of the anode voltage. This may cause a general reduction of amplification by the negative bias of the collecting grid which then arises.

If such an effect is feared, or if for other reasons a too strongly negatively biased collecting grid is not desired, then according to Fig. 5, the collecting grid can be brought to earth potential as regards alternating current by means of a high-ohmic de-coupling resistance **13** and de-coupling condenser **14**, while it is at cathode potential or at some other desired potential as regards direct current.

In particular, if the internal resistances of the tubes **2** are not very great, it is desirable, for obtaining maximum selectivity in the circuits **3**, to make the ratio of capacity to the inductance large, that is, larger than usual.

Furthermore, it is desirable, in the arrangements discussed here, to make the ratio of capacity to the inductance in the series resonant circuits **8**, **9** very small, that is, in contradistinction to the anode circuits **3**, to make the capacity **8** very small and to make the inductance **9** large, without this, however, positively having to be the case.

In particular, in the modification of the inventive idea as illustrated by Fig. 5, with a back-coupling having a tuned action, it is unnecessary, owing to the high selectivity obtainable in any case and owing to the great stability of the back-coupling obtainable between the two tuning circuits, to use circuits which are constructed particularly low in losses.

It has been found, on the contrary, that excellent separating sharpnesses can also be obtained in very cheaply constructed circuits. In this case the back-coupling by no means has to be critically adjusted. With a medium back-coupling adjustment, which already produces a very high separating sharpness, the stability towards voltage variations is so great that even an anode voltage increase from 200 to 500 volts does not effect any self-oscillation. Even at anode voltage variation between 100 and 500 volts, no perceptible de-tunings occur in the circuits.

However, it is by no means necessary for the construction of arrangements according to Fig. 4 or Fig. 5, to use only pentodes or other screen-grid tubes, but very useful selectivities and amplifications can also be obtained even with triodes in this manner. By means of the stable back-coupling, the damping produced by small tube resistance in the directly or inductively-coupled anode oscillatory circuit can also be compensated in this case.

This is a circuit which is noteworthy, also because it allows of using two tuning circuits in a triode without self-oscillation occurring owing to the anode-grid capacity, as would be the case when using tuned anode and grid circuits.

If a tuned circuit is likewise connected to the input grid of a tube, which is provided, for instance, according to Fig. 4 or Fig. 5, with two tuned circuits in the anode and cathode supply lead, then undesired coupling phenomena may occasionally arise owing to the capacity between the input grid, which is usually situated nearest to the cathode, and the cathode itself. In such cases, it may be preferable not to choose as input grid a grid situated adjacent the cathode, but to arrange between the cathode and input grid one or more auxiliary grids. For instance, a space-charge grid may be provided between the cathode and input grid.

In order to supply the cathode emission current to the tube system and in order to produce as uniform a resistance as possible for the frequencies which differ from the natural frequency of the oscillatory circuits, the series combination **8**, **9** in the constructional examples shown is bridged over by a resistance **4**, which determines the degree of the negative back-coupling for the frequencies which are not desired. However, this resistance may also be omitted, in which case a choke coil is preferably connected in parallel with the condenser **8**, as is shown in dotted lines in Fig. 5.

The arrangement shown in Fig. 5, as has already been mentioned, is so constant in the back-coupling adjustment, that a rather extensive removal of damping, particularly if an additional screening grid is provided between the input grid and cathode, is possible even with the existence of several stages connected in cascade.

As has already been mentioned when discussing Fig. 4, special effects can be obtained by de-tuning the series resonant circuit **8**, **9** with respect to the anode circuit **3**, so that, therefore, different resonant frequencies are provided for these two circuits. Also, instead of series resonant circuits in the cathode supply lead for for the purpose of obtaining selective counter-coupling in the anode circuit, parallel circuits may be provided alone or in addition to the series resonances, in order to suppress particularly undesirable oscillations, as may be desirable, for instance, in mixing arrangements of superheterodyne receivers. Also, instead of simple resonant circuits, networks which are more complicated may be provided on the cathode or anode side, and which have not a single but several preferred frequencies or frequency ranges, or suppress or pass broader frequency ranges.

Indirectly-heated or other equi-potential cathodes are particularly suitable for the cathodes, but directly-heated cathodes may also be employed. In this case, the tuning coil **9** and the choke coil connected in parallel with the condenser **8** are then preferably made from the

cathode supply leads. To this end, there can be made from these two heated leads a cable of two twisted conductors insulated from one another, from which the said coils are wound. Any parallel resistances 4 need then be connected only on one side direct to the cathode, since, in comparison with these high-ohmic resistances, the cathode resistance is negligible. Of course, however, also a connection at the real or electrical centre of the cathode could be effected.

A further constructional example of the idea of the invention is shown in Figure 6. Here, there is shown a possible application to a so-called "single-span" superhet receiver, that is, a superheterodyne receiver in which the tuning is effected merely by the variation of the oscillator oscillation, whereas the input circuit is aperiodic, since the disturbing oscillations are removed by the use of a fixed filter in the input circuit and by employing a relatively high intermediate frequency.

By this, however, it is not intended to mean, for instance, that the features shown would not also be advisable in ordinary superheterodyne receivers or other sets.

The tube 15 is a mixing hexode, the tube 16 a pentode which acts as intermediate frequency amplifier and audion, and the tube 17 the loudspeaker tube. In the cathode supply lead of the tube 15 there is provided a series resonant circuit 18, 19, which is tuned to the intermediate frequency.

This has the selectivity-increasing effect for this frequency and, in addition, has the advantage that for the other frequencies, owing to the negative back-coupling which arises, a linearisation occurs, the magnitude of which can be adjusted by variation of the resistance 20. From the resistance 20, moreover, the most favourable grid bias for the input grid of a mixing tube is derived by means of a slider.

Owing to this linearising effect, cross-modulation is avoided to a great extent for all the oscillations which reach the input grid of the tube, so that, therefore, even when using a somewhat curved tube characteristic, as may be desirable for volume control purposes, the advantages of a purely multiplicative mixing are existent to the highest degree.

Since a quartz crystal 21 is coupled to the anode circuit of the mixing tube, the tuned anode circuit 22 is very poor in capacity, that is, is only designed as a tunable choke. By back-coupling the coils 19 and 22, an increase or reduction in sensitivity (according to the direction of coupling) as well as a regulation of selectivity can again be effected.

If the tube 15 is constructed as an exponential tube, then a volume control can be effected in a very effective manner by means of the slider at the resistance 20.

The tuning is effected, as has already been mentioned, merely by adjustment of the oscillation frequency of the oscillator 23. For the purpose of a most favourable coupling adjustment, the small coupling capacity 24 is made variable.

The tube 16 contains likewise a series resonant circuit 28, 29 in the cathode lead, as well as a tuned anode circuit 30 in the anode lead.

The grid bias is derived through a high-ohmic resistance 25 from the counter-coupling 25 from the counter-coupling resistance 26. The crystal 21 as well as the remaining tuned circuits are adjusted to the intermediate frequency.

By coupling the coils 29 and 30, a back-coupling can be introduced in the tube 16. In certain circumstances, the circuit 30 may, in this case, be replaced by a simple back-coupling coil. The crystal 21 therefore acts as an additional tuning member as well as an audion blocking condenser.

Between the crystal and the negative bus-bar, the variable inductance shown in dotted lines may be inserted. This inductance may be adjusted with the capacity of the crystal 21 to series resonance for the frequency to be received or an adjacent, particularly lower frequency, and may then have the following action:

Since the resonance curve of the coupling inductance 22 is relatively broad, then in spite of the selective properties of the crystal, a number of indesirable oscillations would eventually reach the input grid of the tube 16. If a series resonance path is produced by the inductance shown in dotted lines, between the grid and earth for these frequencies reproduced, after amplification, by the choke coil 22, then the grid is practically short-circuited for these frequencies. Only with the narrow frequency band to which the crystal responds is the series frequency disturbed and thus the input grid of the tube 16 excited.

Therefore, in the tube 16, both an amplification of the intermediate frequency and an audion effect occur and the low-frequency currents obtained are supplied through a transformer 27 to the final tube 17.

In the Figures hitherto described, direct or alternating current resistances inserted in the cathode lead have always been shown as counter-coupling means.

Figure 7 shows another form of construction of a counter-coupling which has similar effects. Here, in a tube 31 which has, in a manner well-known per se, a tuned anode circuit 32, a connection 33 from the anode to the grid is provided.

Since, as is well-known, the anode voltage is displaced 180° in phase with respect to the grid voltage, then by suitable return of a part of the anode voltage to the grid, a counter-coupling can be obtained. By varying the resistance 34, the level of this returned voltage can be favourably adjusted. If this resistance is so adjusted that the voltage impressed from the anode circuit upon the grid is equal to the input voltage reaching the grid, then no amplification occurs at all, since the two voltages having, as mentioned, a phase displacement of 180°, neutralise one another.

If, in addition to the resistance 34, a tuned circuit 35 is provided, then since this tuning circuit constitutes a high resistance for its natural frequency, only a small counter-voltage will be transmitted at this natural frequency to the input grid and, therefore, this frequency is amplified. It is therefore seen that owing to the circuit 35 a further means of selection is provided, which can be used independently or together with other tuning circuits as, for instance, the circuit 32, for separating desired frequencies.

In tubes with a very high amplification factor, the resonance resistance of the circuit 35 may not be sufficient in certain circumstances. It can be then increased by a suitable back-coupling arrangement, or altenatively, several circuits 35 may be connected in series.

A further constructional example of the inventive idea is illustrated in Fig. 8. As has already been mentioned, it is necessary for the ob-

taining of the highest possible selectivity that the counter-coupling shall be made as strong as possible for all undesirable frequencies. However, in arrangements, for instance, according to the constructional examples shown in Figs. 4 and 5, this means that the resistance 4 is made high and that also the resistance 8, 9 is to be very high for all frequencies, with the exception of the resonant frequencies.

This resistance, however, becomes greater, the smaller the capacity and the greater the inductance of this circuit can be made for a given wave-length.

Since it is essential that for this purpose all stray capacities shall be reduced if possible, for which reason also the corresponding cathodes are to have the smallest possible capacity with respect to their heating body or other apparatus parts, it is also preferably to make the coils 9, 19, 29 or the like as small as possible in order to make them poor in capacity. Since, in this case, however, the mutual spacing between the turns must not be reduced too much for the same reason, a small copper cross-section and thus a relatively high effective resistance of the coils, of course, results.

In order apparently to reduce this effective resistance which, of course, is also maintained in the case of resonance and which acts for the resonance frequency as a counter-coupling, the use of back-coupling has already been recommended, which, however, is not irremissible.

The construction example in Figure 8 shows a possibility of completely avoiding the occurrence of a counter-coupling even without back-coupling for the case of resonance.

36 is an amplifying tube, to which input voltages are supplied through the transformer 37. To the anode of the tube 36, for instance, a tuned anode circuit 40 is again connected. The amplified currents are kept away from the anode voltage source by the de-coupling resistance 41 and pass through a blocking condenser to a network, from which the counter-coupling voltages or back-coupling voltages can be derived.

In the present case, a counter-coupling is to be effected again for all frequencies with the exception of a desired frequency.

The above-mentioned network is so arranged that for the desired frequency even without the use of an additional damping-reducing back-coupling, no counter-coupling voltages can arise at the input grid.

For this purpose, in the first instance, the series combination 38, 39 is again tuned to the desired frequency. Then, by means of the variable coupling 42, an adjustment is effected at which for undesired frequencies an adequate counter-voltage arises at the input grid of 36. By the tuning of the condenser 43 and adjustment of the resistance 44, there can then be found upon subsequent correction at the condenser 38 a position at which absolutely no counter-voltage arises for the desired frequency at the input grid.

If, instead of the filtering-out of a certain frequency from a frequency mixture of undesirable frequencies, the suppression of an undesirable frequency in a larger frequency mixture is aimed at, then in all the arrangements described here this can be achieved by providing a parallel resonant circuit at the points where a series resonant circuit is provided, while, on the other hand, at those points where a parallel resonant circuit is provided, this is replaced by a series resonant circuit.

A very material advantage of such arrangements for increasing selectivity resides in the fact that the two main functions hitherto carried out in a resonance amplifier by the coupling oscillatory circuits or the like can be separated and, thus, more favourable results can be obtained.

In a resonance amplifier working, for instance, with tuned anode circuits as coupling means, the case was hitherto such that the tuned anode circuit determined both the obtainable amplification and the selectivity of the particular stage. It was, therefore, necessary to effect a compromise. Thus, for instance, if importance was attached to very high selectivity, the ratio of capacity to indutcance in this oscillatory circuit had to be kept at a certain value, which could not be reduced. The higher the inductance of this circuit, the higher is the obtainable amplification in general.

The highest dynamic resistance results (if no excessive damping is provided), as is wellknown, if the oscillatory circuit merely consists of the natural capacity of a coil and the inductance of this coil. However, since in such a case the selection is usually insufficient, the high amplification which is possible in such an arrangement generally could not be utilised.

Since it has now been found that by arranging a tuned counter-coupling channel and, in particular, by means of a series resonance circuit, which may be arranged at any point between the anode and cathode, preferably between the cathode and the negative pole of the anode voltage source, a very substantial increase of the inductance can be otbained, much greater latitude is obtained in the choice of the values for the anode circuit serving as coupling member.

In such a resonance amplifier, which was tuned to 1600 kilocycles and constitutes the intermediate frequency amplifier of a "single-span" superhet receiver, it was found, for example, that the half-value width, which was obtained by means of a series resonant circuit situated between the cathode and negative anode voltage pole, was so much less, than the half-value width obtainable with a normal anode tuning circuit alone, that this tuned anode circuit in practice hardly contributed to the obtaining of the tuning sharpness.

Therefore, without renunciation of separating sharpness, this anode tuning circuit could be varied at will (on the condition that the internal resistance of the tube is still large in relation to the dynamic resistance of the anode tuning circuit, a condition which is generally fulfilled in normal high-frequency pentodes) without the tuning sharpness substantially determined only by the cathode series resonant circuit varying, and, therefore, when choosing a very small capacity and very high inductance, it is possible to obtain for this anode tuning circuit amplifications with good selective properties of the amplifier, which are not obtainable with normally-constructed amplifiers.

The assumption for the best possible outputs is definitely that certain conditions are fulfilled which are generally to be fulfilled with normal tubes.

In the constructional examples discussed with reference to Figs. 9 to 13, it is assumed in this case that the tuned back-coupling or counter-coupling channel is formed by a series resonant circuit inserted between the cathodes and negative anode voltage source; if, instead of this tuned coupling channel, a different channel is chosen, the constructional examples described here for

series resonance in the cathode supply lead are to be suitably modified.

When using tubes usual in commerce, it has been found that, in the first instance, the capacity between the input grid and the cathode is very undesirable, particularly if a tuning circuit is connected to the input grid. By the use of a neutralising arrangement, the effect of this undesirable capacity may be removed.

The neutralisation may, inter alia, be so formed that the tuned grid circuit produces, either by purely inductive means in a coupling coil, or by additionally winding a few turns on the earthed side of a grid inductance after the fashion of a spare transformer, a counter-voltage, which now acts through a neutralising condenser upon the cathode, or, alternatively, in a similar manner, a neutralising voltage may be produced by the coil of the series resonant circuit lying in the cathode, the neutralising voltage so obtained then acting through a neutralising condenser, a so-called "Neutroton", upon the control grid.

In addition to this cathode-control grid capacity, however, the anode-cathode capacity is also very undesirable. Since a series resonant circuit is situated in the supply lead to the cathode according to the above, an undesirable coupling or counter-coupling easily arises between the anode of the tube and cathode, if appreciable capacities are effective between these two electrodes.

This becomes particularly disturbing again when an oscillatory circuit is connected not only to the anode of the tube, but also to the control grid, as is usual in tuned series amplifiers. Since the grid oscillatory circuit in spite of neutralisation with respect to the cathode usually still has a residual coupling to the cathode circuit and since, on the other hand, owing to the capacitive or other stray coupling which exists between the cathode and anode the anode circuit is also coupled to the cathode circuit, the maximum amplification usually cannot be stably utilised, since in this way energy returns through the cathode circuit to the grid circuit and the arrangement then commences to oscillate.

A large part of these detrimental couplings arises within the tube, namely, in the base and in the pinch, and it is therefore desirable also to neutralise or, in order to obtain best results (when using the series resonant circuit in the cathode supply lead, otherwise, as already mentioned, variations must be suitably effected) to use a tube construction according to Fig. 9.

This tube **60** is constructed, for instance, as a pentode with the one difference that between the control grid **61** and the cathode an electrode **62** constructed as a screen-grid is also provided, which by application to weakly positive potential with respect to the cathode can simultaneously exert the steepness-increasing effect of a space-charge grid.

This grid **62** terminates at both ends in solid tubular extensions **63**, **64**, which extend beyond the ends of the other electrodes. The tubular extension **64** also protects the parts of the filament **65** which are situated outside the cathode **66**, so that no disturbing influence of the amplifying operation can be caused by them, while the tubular extension **63** preferably merges into a conical part **67**. This conical part extends, if possible, up to the glass wall of the tube, in order to provide an effective screening of the cathode supply pole **68** arranged at the upper end of the tube envelope, from the other tube electrodes. Since the conical part **67** of the space charge screen-grid **62** (but a space charge effect at this grid may also be renounced, in which case it can then be more weakly or more strongly negatively biased), if it were to extend close to the glass wall and were to consist of massive metal, might easily present difficulties in de-gassing, then in the constructional example of Fig. 9 there is attached to the conical metal part, which only has about 5 mm. projection with respect to the grid diameter, a conical extension of metallised mica slotted in sector fashion. This metallised mica cone has a screening effect similarly as if it were to consist of massive metal; since, however, on thorough heating with high-frequency eddy currents owing to the high resistance of the thin metal layer or other conductive layer on the mica, the latter is not heated to a very high temperature, then no breaking of the envelope dome owing to contact with the screen can arise.

The grid **62** is followed, reckoned as next from the cathode **66**, by the actual control grid **61**. This control grid receives its supply, contrary to present-day practice, through the pinch. Since the control grid is generally connected in any case to an oscillatory circuit, the capacity existing between the control grid and the other electrodes in the pinch, which are earthed as regards high frequency, only enters the arrangements as additional oscillatory circuit capacity and is therefore harmless.

The cathode **66**, on the contrary, is to have, according to the above, as small a capacity as possible both with respect to the control grid and with respect to the anode **69** and, moreover, as small a capacity as possible with respect to any other electrodes. Therefore, as shown in the constructional example of Fig. 9, an outgoing lead **68** at the top of the tube envelope is advisable. Moreover, it is advisable to make the distance between the cathode body **66** and filament **65** as large as possible in order to keep the cathode capacity low with respect to earth, since it is thereby possible to give the cathode series resonant circuit a very small tuning capacity and thus high selectivity. The cathode may also be made rather short in order to achieve this object; the deficiency in steepness possibly resulting in this case can be removed again by the action of the space-charge grid **62**.

As third electrode from the outside, the well-known screen electrode **70** follows, which is generally at positive potential and which is extended at the top and bottom again by plate-shaped members **71** for improving the screening of the electrodes from one another. In order to bring the plate-shaped members again close to the glass wall or to the screening coating provided inside and/or outside on the glass wall, metallised mica plates or mica plates coated with thin foil, for instance, resistance material, may be used.

Reckoned as the last grid from the cathode, a collecting grid **72** then follows, which in turn is surrounded by the anode **69**.

Instead of the pentode-like tube described here, hexode, septode or octode-like tube structures may also be employed.

Moreover, it may be preferable to use instead of a pentode-like arrangement, a mere screen-grid tube arrangement, in which the collecting grid is omitted. In particular, it is preferable to work, according to the principles of the well-known Harries tube, with a critical, fairly large distance between the anode and the screen-grid,

Thereby, the anode-earth capacity is considerably reduced and, therefore, a still higher L—C ratio may be given to the coupling oscillatory circuit to be connected to the anode, which inter alia acts favourably for the obtainable amplification.

A construction according to electron-optical aspects also furnishes, inter alia, advantages, particularly in this respect. The anode **69** has a special lead-out terminal **73** direct through the glass wall. As is shown, the tube **60** is cylindrically shaped with the exception of the constriction of the dome envelope, so that the construction with the screening plates extending close up to the tube wall can be introduced from the bottom into the tube.

The fused seam between the plate and envelope therefore lies further outside, which stipulates a large diameter of the tube base. However, in the present case, this is not undesirable, since the tube base is preferably made of metal or is metallised and forms an additional covering of the holes serving for receiving the tube, in the screening boxes of the amplifier, as is apparent from Fig. 10.

If the tubes are introduced from the bottom into the screening boxes, then the screening boxes must have a recess for the passage of the lateral anode terminal **73**. This passage is then closed by the tube base when the tube is introduced.

Also otherwise, the larger tube base is not undesirable owing to the larger distances between the individual feed wires and the good insulation etc. thereby possible.

In order to assemble the tube in a simple way in spite of the two envelope contacts, the supply leads to these two contacts are made resilient, the dome contact having a resilient pin, which engages in a sleeve-shaped continuation of the cathode body, while there is fixed to the anode a resilient contact tongue, which comes into connection with the lateral contact point at the envelope when the system is inserted in the envelope in the manufacturing operation.

Since, in practice, usually vacuum tubes or tubes filled with inert gases will be in question, danger to the contact by oxidation need not be feared. Frequently, however, it may happen that, owing to the heating of the metal parts which is necessary for the expulsion of the gas, the elasticity decreases and then the contact becomes unsafe. It is then necessary to produce the resilient parts in such a manner that even when using ductile material, the resiliency is maintained, or provision should be made for a subsequent permanent connection of the parts making contact in the envelope.

To produce such a permanent connection the following method has proved highly successful. Those two parts which are to be connected together are made of a material which has a relatively high melting point. The two contacting parts or at least one of the two is then coated at least at the point of contact, with a material which has a lower melting point and then, after assembly of the tube, that is, preferably in the de-gassing operation, in which the metal parts of the tube are highly heated by electron or ion bombardment or by thorough heating by means of high frequency eddy currents, the contacting parts are so highly heated that the material of low melting point, which surrounds one or both parts at the point of contact or is applied to the point of contact, fuses, whereby the two parts to be connected are then connected by a kind of soldering process. This method can be quite commonly employed in the construction of tubes or the like.

It has proved particularly successful in the present case in fixing the anodes to the lateral fused-in portions already previously arranged in the envelope. The anode was made in this case, for instance, from nickel wire network and the end of the lateral anode supply wire fused into the envelope also consisted of nickel. The nickel wire end, which was about ½ millimetre thick, was covered with fine silver wire (about 0.2 mm) and was mechanically biased in such a manner that the wire end resiliently pressed on the anode body approximately over a distance of 2 to 3 mms. On thoroughly heating the anode with high-frequency eddy currents, the silver then melted and connected the anode gauze with the supply wire by hard soldering. If, in the case of the connection, it is not a question of bodies which can be conveniently heated up like an anode from outside by high frequency, it is advisable to effect the point of connection at a small metal plate or metal ring or metal bow specially provided for this purpose, which can be heated up from outside by induction currents.

Although in the present case the use of this method was chiefly described for lateral fused-in portions at the tube envelope, the method can accordingly be applied to all other cases in which the making of a durable connection in vacuo is important, that is, also in the case of the connection of the cathode lead-in arranged centrally on the envelope dome.

The getter pill is preferably arranged between the upper screen of the cathode screen-grid and the upper screening plate of the anode screen-grid. On vapourising the getter, the result is then obtained that, firstly, these two screening plates are metallised, which is desired according to the above and renders it superfluous to use already metallised mica in the assembly, whereas, on the other hand, since this space is screened on all sides against the remaining electrodes and the holding wires, the result is obtained that no getter deposit can form on insulators and glass parts at places where it might be detrimental for the operation of the tube.

The constructional elements mutually supporting the individual grids, as, for instance, holding parts of mica, ceramic material or the like, are not shown for the sake of clearness; these parts may, however, be constructed in such a manner that e. g. between the anode and cathode screening plate, between which the getter is supposed to be situated, all the other grid holding wires or the like are covered by the said insulators; if a deposit forms here on the insulator, this deposit may merely connect together the cathode and anode screening plate. By means of a current impulse between the two corresponding electrodes, the conductive bridge which possibly forms may then be interrupted. Any remaining weak "creeping" current path, however, is harmless, since both electrodes only carry direct current potentials and are earthed as regards high frequency or alternating current.

Fig. 10 shows a diagrammatic section from a suitable arrangement for the construction of such a series amplifier. In this figure, only the high-frequency circuits situated between two tubes are shown, but, of course, such an amplifier may be provided with almost any number of stages and, therefore, the arrangement shown in Fig. 10 must

be imagined to be continued to the right or left in the sheet of drawings in this case.

81 and 82 in this case are tubes which are constructed after the fashion of Fig. 9. 83 are the metal walls or metallised walls of screening boxes. The voltage to be amplified is supplied to the grid supply lead 84. The tuned anode circuit 85 is connected to the anode terminal 86 of the first tube and is connected in a manner well-known per se through a coupling condenser 87 and a leakage resistance 88 to the grid supply lead 89 of the next tube. The cathode supply lead 90 of the first circuit is connected to the earthed mass of the screening boxes 83, which is connected to the negative anode voltage pole, through a series resonant circuit which consists of an inductance 91 and a capacity 92.

Since the cathode lead 90 only has a low capacity with respect to other apparatus or tube parts owing to the particular construction of the tube, the regulatable capacity 92, which is tuned together with the coil to the frequency to be amplified, may be made rather small, without there being produced by the effect of the stray capacity of 90, a parallel resistance to the series combination 91, 92 which constitutes for the frequencies departing somewhat from the resonance frequency a smaller resistance than this series combination itself, so that the latter becomes ineffective.

Of course, there may be cases where, even if the capacitive leakage resistance, owing to stray capacities, becomes relatively small with respect to the resistance of the series circuit in the non-resonance condition, an adequate selectivity increase by the series circuit is nevertheless obtained. Generally, however, the difference of the resistance effective between the cathode and mass may be as large as possible between the resonance condition and non-resonance condition, in order to produce resonance properties which are as pronounced as possible.

When choosing the tuning values, and also in all other cases in the art, a compromise is necessary. The smaller the capacity 92 becomes, the greater is the resistance of the circuit 91, 92 for non-resonance frequencies. On the other hand, however, a further increase of the resistance 91, 92 for non-resonance frequencies has no longer any great purpose if there is produced by the stray capacities from the cathode contact 90 to other parts of the tube or of the apparatus a parallel resistance which is considerably less than the resistance of the combination 91, 92.

The losses in the coil 91 also increase with progressive reduction of 92, and since these losses also appear in the resonance condition as effective resistances, the desirable large difference between the resonance resistance and non-resonance resistance is thereby reduced. Moreover, the obtainable amplification per stage is reduced by the effective resistance remaining in the resonance case as an ohmic counter-coupling resistance. Where, therefore, a residual counter-coupling for the purpose of the linearisation of the amplifier characteristic is not desired, as, for instance, in mixing tubes in superheterodyne receivers and the like, the reduction of the capacity will therefore only be taken so far that only a small value results in the case of resonance as effective resistance of the complete circuit.

In 1,600 kilocycle-amplifiers, for example, a form of capacity 92 which is illustrated in Fig. 10 has proved successful. At a threaded spindle which runs in a threaded bearing insulated against the screening boxes 83 there is provided a plane, circular plate of about 20 millimeters diameter, which can be moved towards or away from the screening wall for the purpose of tuning. For safeguarding against short-circuits, the casing wall may be protected at the point situated opposite the condenser, by an insulating coating, as indicated by a line in the drawing.

The choke 93 and the resistance 94 are connected in parallel with the series combination 91, 92. The resistance provides for the production of the required grid bias, whereas the choke 93 within the frequency range coming into question is to represent a high high-frequency resistance, so that the effectiveness of the combination 91, 92, is not reduced by the parallel resistance being too small. The fact that by means of such a choke, resonance positions within more remote frequency ranges can possibly be produced, is usually insignificant, since more remote frequency ranges can be adequately weakened by the tuned anode circuits 85 of such an amplifier.

As is apparent from the diagrammatic circuit diagrams, it may be preferable to couple the coils of the oscillatory circuit 85 and the cathode coils 91, which coupling, according to the sense of coupling, may act as a stabilising counter-coupling or as a damping-reducing back-coupling. If, for instance, a very high frequency is amplified, then in spite of the most careful screening measures, the internal tube capacities may suffice to cause a tendency to oscillation even with, in particular, multi-stage amplification. In this case, with the said coils, a stabilisation can be obtained by means of a certain counter-coupling, so that here the coupling serves as a method of neutralisation. On the other hand, however, by means of a back-coupling effect between the anode and cathode circuit, a very considerable amplification increase and selectivity increase can be obtained.

The desired adjustment of the mutual coupling of the two coils can be obtained in a manner well-known per se by making one of the two coils rotatable. If the desired sense of coupling is fixed, the two coils may also be firmly arranged and only the opening 95 in the screening wall separating the two coils may be more or less constricted by a screening flap and thereby the action of the two coils on one another may be regulated.

Since, with the high amplification generally occurring here, most careful screening is important, a grid of parallel wires or the like which is indicated by short transverse lines is provided in the opening 95, which grid, particularly with an arrangement of these parallel wires which is insulated on at least one side, makes it possible to prevent in practice an electrical action of the two coils and corresponding circuit parts on one another, while an inductive mutual influencing takes place.

The tubes 81 and 82 are inserted from below in the corresponding screening boxes. Therefore, in the circular opening serving for receiving the tubes, recesses are provided in at least one screening wall for the passage of the anode terminals 86. If the tubes are insulated, these passages are covered by the base flanges 96.

If specially constructed tubes according to Figs. 9 and 10 are not used, the subject of the application can, of course, also be carried out, but the obtainable advantages are fewer. If, while using ordinary commercial tubes, it is desired to derive

the full advantages which the subject of the application offers, this can be done in various ways.

One possibility is illustrated in Fig. 11. Between two tubes, which, according to this invention, work with an additional coupling channel, in the present case with a series resonance provided in the cathode lead as a counter-coupling, in which case the series resonant circuits of the cathode lead may be inductively coupled with the tuning circuits provided in the anode lead, an aperiodically-coupled tube is provided.

In the constructional example of Fig. 11, the first tube is imagined to be a mixing tube and therefore has, in addition to the input grid and the screen-grid, a grid to which the oscillator voltage is applied. This, however, is immaterial; therefore, in a tube amplifier, the first and third tube could also be uniformly constructed.

Between the first and third tubes, an aperiodically-acting tube is inserted, in the present constructional example a pentode. Since pentodes or even only screen-grid tubes are on the market, in which the anode has a special connecting terminal provided on the envelope, it is possible by means of the circuit connection shown in the drawing, of a pentode or of an ordinary screen-grid tube, to obtain the result that the anode circuit of the first tube is not coupled to the cathode circuit of the third tube through a grid-capacity, since, of course, the grid of the third tube is connected to the anode of the second tube and the anode of the second tube is screened from the input grid of this tube and thus from the anode circuit of the first tube by a screen-grid.

The capacitive coupling between the anode circuit and cathode circuit of the first tube on the one hand and of the third tube on the other is definitely maintained if these two tubes have no special outgoing anode supply leads. These capacities, which are mainly existent in the tube bases, can be removed, however, by an inductive counter-coupling (see arrows) to the extent desired. Since, in general, a back-coupling effect in the individual stages is desired, a complete neutralisation by counter-coupling will generally not be effected.

Since the central tube, particularly at higher frequencies, does not contribute much to the amplification, it is desirable to limit the expenditure for this as much as possible.

Fig. 12 shows an example of how cheap single-grid tubes can be used for this purpose, in which case, to obtain the best effects, it is desirable that the anode supply lead shall be specially led out of the envelope. The output voltage of the first tube in Fig. 11 is applied here to a high resistance lying in the cathode lead.

A favourable grid bias for the screen-grid connected as regards high frequency to the negative pole of the anode voltage and thus to earth is produced by a branch resistance. This is necessary, as the cathode resistance must be high in order not excessively to damp the preceding anode circuit (a certain damping is not detrimental, since it can be compensated by back-coupling in the first tube).

Since, due to this high cathode resistance, the high negative grid bias which would be produced by directly connecting the grid with the negative pole of the anode voltage source, would lock the tube, the arrangement shown in Fig. 12 is chosen, which allows of choosing the grid bias independently of the potential drop in the cathode resistance. From the anode of the three-electrode-tube, the output voltage is again passed on to the third tube of Fig. 11. The grid of the three-electrode tube connected to earth as regards high frequency effects the desired screening between the output circuit of the first tube and the input circuit of the third tube in Fig. 11.

A further embodiment employing tubes usual in commerce is shown in Fig. 13. Here, two tubes are connected in series, in which case, as has already been mentioned in British Specification No. 415,079, attention should be paid to the fact that by the cathode heating of the upper tube, no appreciable leakage to other apparatus parts or to earth takes place. This can be done, as described in the said prior application, by heating the cathode with transformers poor in capacity arranged near to the cathode, or, alternatively, by indirect heating of the upper tube as poor in capacity as possible, as well as by any other kind (photo-emission, secondary emission, virtual cathodes or the like) which allows of producing an emission without an excessive detrimental leakage.

Both tubes in Fig. 13 therefore act practically similarly to a tube with a correspondingly high number of grids. The lower tube may be a three-electrode tube, in which case the control grid is connected as regards high frequency to earth. The nature of the grid-bias variation as shown or some other similar arrangement at this grid may be used for volume control, particularly if one of the two tubes or tube systems is constructed as an exponential tube.

In the cathode supply lead of the tube, furthermore, the series resonant circuit is provided. The anode supply lead is again separately led out of the tube if possible.

The input voltage is then applied to the control grid of the upper tube, while the anode of the upper tube is screened against this control grid by a screen-grid kept at a positive potential. The desired screening between the control grid and anode is then produced again by the last-mentioned screen-grid, whereas by means of the control grid which is earthed as regards high-frequency in the lower tube, a screening between the upper control grid acting as input grid and the series resonant circuit situated in the lower cathode supply lead is obtained.

Instead of the upper tube, the lower tube may also be provided with two control electrodes; the upper tube may then be a single-grid tube. This case is illustrated by the second grid shown in dotted lines in the lower tube.

In the case of Fig. 13, the additional expenditure of a special tube is also necessary for the decoupling; however, since both tube systems fully amplify here, an advantage exists over the arrangements shown in Figs. 11 and 12 with aperiodically-acting coupling tubes, which may be desired in many cases.

In the description of Figs. 9 and 10, it has already been pointed out that it is advantageous to avoid as far as possible the capacity between the cathode and the cathode heater. This requirement can be complied with by means which bring the cathode to emission in a different manner. There may be mentioned here photo-emission, thermal emission by radiation, secondary emission or virtual cathodes, etc.

A further means consists in reversing the usual practice and inserting the coupling resistances, which connect together the individual stages of an amplifier, that is, in the present case, for example, the tuned anode circuits, in the cathode

lead, and transferring the series resonant circuits into the anode lead. In this case it may be preferable to earth also the anode side instead of the cathode side of the amplifier.

Since the anodes, of course, do not necessitate any heating leads, then, particularly if care is also taken by the other construction of the amplifier (for instance, after the fashion of the Harries tube) that the capacity of the anode to screening electrodes etc. remains small, the condition of the existence of minimum leakage capacities at the series resonant circuits which is sometimes desirable as already explained above, can be produced. Moreover, particularly when using tubes customary in commerce, an undesirable coupling between circuits can often be avoided by the coupling circuits in the case of successive amplifying stages lying alternately in the cathode supply lead and anode supply lead, while series resonant circuits also lie alternately in the cathode and anode supply lead of the individual stages.

In the case of octodes, hexodes and septodes etc. it is often possible, merely by an alteration in the arrangement of the base or of the leads led directly out of the envelope, to produce the screening desirable in the case of the present application, without introducing further additional electrodes and without coming into conflict with the usual mode of operation and the fields of application of these tubes.

In order not to obtain any detrimental couplings through the heating leads at the voltage sensitivity of the cathodes which is existent in the case of maximum utilisation of the advantages of the subject of the invention, it may be preferable to arrange the heating leads in such a manner that all the heating leads, while screened from the individual tubes, are led to a common connecting point, at which the leads are connected through large condensers to earth or chassis. Possibly, special de-coupling means may be provided in the supply leads of the individual heaters to this common connection to the source of heating voltage.

The screen, of course, need only extend so far as the heating leads must be passed through non-corresponding screening spaces.

Since the series resonant circuits provided in the cathode leads are bridged over either by choke coils or resistances, the values of which are determined by the degree of the counter-coupling desired in the case of non-resonance and, therefore, there may arise in the resistances a potential drop which does not coincide with the desired grid biases, care should be taken that the grid bias can be derived from these resistances independently by tappings or the like, as is shown in Fig. 12. If variable grid bias is desired, the grid bias is therefore to be variable independently of the value of the resistances lying in the cathode supply lead.

If, for certain reasons, the arrangements of Figs. 11, 12 and 13 or similar arrangements are preferred to the arrangements of Fig. 9 or 10 or the like, it may be preferable to combine the tube systems serving for de-coupling or screening (central tube of Fig. 11 or tube of Fig. 12) with a preceding or succeeding tube system to form a multiple tube. The same applies to the two systems of Fig. 13.

Instead of two tube systems, of course, a larger number of tubes according to Fig. 13 may also be connected together.

Among other advantages, only small stray capacities exist in multiple-tube structures.

If there exists between two circuits, for instance a cathode series resonant circuit and an anode tuning circuit, a coupling which is unfavourable for the amplifying operation in the whole amplifier, while the anode circuit in itself still shows an undesirable broad tuning, it may be preferable to produce a neutralisation by counter-coupling between the series circuit and the anode circuit, and to eliminate the damping of the anode circuit by additional damping-eliminating means, for instance, a back-coupling, on the collecting grid from the anode circuit. Therefore, in this case, too small a damping at one point is compensated, whereas at another point too great a damping is reduced in the same tube.

Hexodes or the like are still more favourable than pentodes for such cases, since the third grid, reckoned from the cathode, that is, the second control grid of a hexode is more suitable than the collecting grid.

Other counter-coupling channels may just as well be advantageous, of course, under altered circumstances. Thus, for instance, a counter-coupling through the second control grid of an hexode may be advantageous. Likewise, such counter-coupling arrangements may be inserted in the screen-grid leads.

In the case of very sensitive arrangements, it may be important to screen the cathodes against the filament by additional metal envelopes or grids earthed or brought as regards high-frequency to earth potential.

If, as has already been mentioned above, tubes according to Fig. 9 or the like are constructed, then the space-charge grids serving as screen or intermediately positioned grids may be used for modulation purposes or the like, since such functions of additional grids, of course, generally do not prevent the latter from acting simultaneously as screen.

Therefore, for instance, in transmitting amplifiers, such auxiliary grids may be used at the same time for modulation purposes as well as in intermediate-frequency receiving arrangements.

As has already been mentioned, an arrangement in which tuning means substantially according to Fig. 10 are provided in the cathode and also in the input and output circuit has the great advantage that there is a material selectivity increase with respect to the simple anode circuit coupling.

For many cases, so-called band-filter couplings are known, in which therefore at least two resonant circuits are provided between the output side of a tube and the input side of a next succeeding tube. Such amplifiers, however, have the drawback as compared with simple anode circuit coupling, that in the best case only 50% of the total amplification otherwise possible can be obtained, while this limitation does not exist in the present arrangement.

However, the other advantages of the band-filter coupling can also be obtained with the subject of this invention, for instance, an almost optional broadening of the resonance curve, without the flank steepness being highly affected in this case. This can be achieved in itself by employing in the counter-coupling channels, that is, for instance in the cathode supply lead or in supply leads to a screen grid, instead of the simple series resonant circuits, chain conductors, such as coupled circuits or the like.

However, such effects can also be obtained with the simple arrangements according to Fig. 10, if the circuits are somewhat detuned with regard to one another within one or more stages. In particular, at very high frequencies, say, in the amplification of broad bands for television purposes, such arrangements are very useful owing to the high obtainable band widths at relatively good total amplification both as straight amplifiers and also as intermediate-frequency amplifiers.

When working with superheterodyne receivers of high intermediate frequency, that is, in particular, "single-span" superhets, it has also been found that it is particularly important to provide good screening of the individual electrodes from one another in the mixing tube.

Thus, for example, the practice generally carried out at the present day, of separately leading out only the control grid in the envelope in a mixing hexode or mixing octode is usually not sufficient. Since, in such receivers, particularly on the reception of long waves, the oscillator frequency shows only quite small (10% and less) detunings with respect to the intermediate frequency, instability easily occurs on the reception of long waves owing to accompanying phenomena or the like. This instability appears to arise inter alia through the base capacities between the control grids, to which the oscillator frequency is supplied, and the anode circuits, which, of course, are tuned to the intermediate frequency.

This detrimental influence is manifested particularly if, as described above in various constructional examples, the cathode circuit is also tuned. Therefore owing to the base constructions or the capacities present therein, an influencing between the oscillator circuit and tuned intermediate frequency circuits or the like inserted in the anode or cathode lead can then particularly easily arise, which has the unfavourable result of a whistling tendency, whistling points etc., especially on the reception of long waves.

Therefore, according to the present application, as is shown in a constructional example in Figs. 9 and 10, care is to be taken that the control grid, anode and cathode are screened against one another as well as possible and separately led out, a separate lead-out of that control grid to which the oscillator voltage is applied being provided in the case of mixing tubes. One of the outgoing leads to be separated, however, for instance, as shown in Figs. 9 and 10 for control grids, may be led out of the envelope together with the screen-grid leads.

A further constructional example of the present invention applied to a mixing tube and intermediate frequency amplifier of a "single-span" superheterodyne receiver is shown in Fig. 14.

In this example, the resistance **101** connecting the cathode of the mixing tube **100** with the negative anode voltage lead serves for counter-coupling. By means of a slider **102** which connects the grid-leak resistance **103** to any desired point of this cathode resistance, the most favourable grid bias of the mixing tube can be adjusted; with the slider **104** shown opposite, which is connected to an earthed condenser **105**, the degree of counter-coupling can be adjusted to the desired resistance.

This counter-coupling has a double effect. On the one hand, it acts in a linearising manner with regard to the frequencies reaching the input grid of the mixing tube and, furthermore, it acts through the agency of the series resonant circuit **106, 107** connecting the cathode to the tuned anode circuit **108**, to increase the selectivity. This series resonant circuit, as is indicated by the dotted arrow, may be adjustably coupled with the tuned anode circuit.

By the arrangement of the series resonant circuit as shown here, which acts to increase the selectivity, two larger condensers are saved, namely, on one hand, the bridge-over condenser usually arranged between the cathode and earth and, furthermore, the de-coupling condenser leading from the anode de-coupling resistance to the earth lead. Thereby, the additional filter effect which otherwise arises owing to these de-coupling condensers and which contributes to the smoothing of the anode current is removed, but since, of course, the counter-coupling is effective also for the alternating current component possibly contained in the anode voltage, such superimposed alternating voltages are considerably less harmful here than in normal arrangements.

Since this is chiefly obtained owing to the absence of the cathode resistance bridge-over condenser, the teaching results therefrom, also is normally constructed high-frequency amplifiers, to choose such an arrangement acting as counter-coupling also for low-frequency disturbances. In a normal high-frequency amplifier, therefore, the bridge-over condensers of the cathode resistance producing the grid bias or of another cathode resistance would intentionally have to be chosen so small, contrary to the former practice, that they are probably sufficient to pass approximately without resistance the high-frequency voltages between the cathode and earth which are to be amplified but that, on the other hand, they are so small that they still constitute a very high resistance for low-frequency disturbing voltages contained in the anode supply current and, therefore, act here as counter-coupling resistance.

This means, as compared with the use of larger cathode condensers of often one or even more micro-farads as is customary at the present day, not only a substantial economy but also a considerable reduction of the alternating current hum and similar disturbances.

The anode tuning circuit **108** of the mixing tube is then coupled through a small capacity **109** to the input tuning circuit **110** of the intermediate-frequency amplifier tube **111**. The coupling between both tuning circuits is to be so loose that no broadening of the resonance curve occurs since at these high frequencies the necessary selectivity is not obtained otherwise. Also with the tube **111** a series resonant circuit **112, 113** connecting the anode circuit **114** with the cathode is provided, which acts to increase the selectivity.

Since the series resonant circuit **112, 113** couples the cathode to the anode circuit, then owing to the control-grid-cathode capacity through this series resonant circuit, a coupling between the grid circuit and anode circuit may result, which would then cause an instability of the amplifier. In order to remove this, there is inserted between the cathode and control grid an auxiliary grid **115** which has a screening effect between these two electrodes. Since, with the series resonant circuits serving for increasing selectivity, it may lead to difficulties if also the anode current of the oscillator tube flows through the cathode resistance of the mixing tube, as may be the case with combined oscillator and mixing tubes (for example, type ACH 1) fre-

quently used at the present day, it is preferable either to use a separate oscillator tube or to transmit the oscillator oscillation inductively to the mixing tube grid.

In order to avoid the undesirable coupling which may arise between the anode and input circuit of the tube 111 owing to the cathode control-grid capacity, without being constrained to employ a separate tube with a screened cathode, a circuit according to Fig. 15 may be advisable. Here, the series resonant circuit is placed between the anode tuning circuit and the positive pole of the anode voltage source. The counter-coupling is effected here by a special condenser C, which only requires a low capacity. In order to supply voltage to the anode, the series resonant circuit in the anode supply lead must be bridged over by a resistance which acts as decoupling resistance. A choke connected in parallel with the series circuit condenser could also serve this purpose. However, since the above-mentioned resistance would be connected in parallel with the input circuit of the tube and, therefore, has a damping and selectivity-worsening effect, it is preferable to connect a choke with the resistance, as is shown in Fig. 15. The series circuit and tuned anode circuit may again be coupled together, as is indicated by the arrow, in which case by adjustment and possible reversal of polarity of the coupling, care may be taken that a removal of damping increasing the selectivity, but no self-oscillation, occurs.

Fig. 16 shows a further possibility of connection. The series resonant circuit is connected here again between the upper anode circuit connection and the cathode. The counter-coupling channel contains, in addition to a condenser, a variable high-ohmic resistance, which serves for adjusting the counter-coupling. The anode circuit and series circuit may then again be coupled together. The cathode may be bridged over with respect to earth by a condenser, which is indicated by the dotted line in the drawing.

Since, as has already been discussed in reference to Fig. 15, a connection of the input circuit with the anode circuit through a condenser C may cause an additional damping of the input circuit, since the resistance serving for supplying the anode current is connected in parallel with this circuit through the condenser C (in an arrangement according to Fig. 16, neutralisation may also be effected by a coupling condenser connected according to Fig. 15, if this neutralising condenser has an approximately equal capacity to the anode grid capacity) the circuit according to Fig. 17 has proved to be useful, where the counter-coupling channel is effected through the capacity C not on the input grid but on another grid, in the present case on the collecting grid of a pentode. Instead of the collecting grid of the pentode, a second control grid may also be employed in the case of a hexode, octode or the like; possibly the screen-grid of a screen-grid tube is also already sufficient. Here also the cathode may again be bridged over by a condenser with respect to earth.

If, for screening of the input grid against the cathode, an additional grid arranged between the cathode and the control grid is employed, as in the tube 111 of Fig. 14, then it is desirable, in order to obtain adequate steepnesses, to bias this grid positively as a space-charge grid. In this case, however, certain difficulties arise. If the "Durchgriff" of this cathode-screen is made small enough to obtain a very effective screening, then this cathode screen, if it acts as a space-charge grid, must itself pass an amount of current which is very large in proportion, in order to obtain a desirable high control-grid steepness in the tube. If, however, the "Durchgriff" of this space-charge grid is made large enough, in which case desirably high steepness can be obtained at the control gride without inconveniently high space-charge grid current, the screening effect is small.

It has therefore proved to be preferable to separate the screening effect and the space-charge grid effect and to arrange directly in front of the cathole a pure screen-grid which is approximately at cathode potential or negative potential and which undertakes the prevention of capacitive coupling between the cathode and control grid; then, outside this grid, an actual space-charge grid with a relatively high "Durchgriff", whereby the necessary steepness is produced at the control grid without the space-charge grid having to receive disproportionally high currents and then to arrange the actual control grid on the outside of this space-charge grid.

A normal pentode would then have to be converted into a seven-electrode tube as shown in Fig. 8.

The leading-out of the cathode and anode is preferably effected directly at the glass envelope, whilst the remaining feeds are normally effected in the pinch of the tube.

The arrangements shown here, however, although they were only indicated for high-frequency amplification are suitable for mixing circuits (in which case preferably at least one grid should also be provided for the introduction of the oscillator voltage) and for all other purposes.

A further interesting use of the series resonant circuit is shown in Fig. 19. Here, a normal pentode amplifier stage is shown, in which instead of a single anode tuning circuit, two such tuning circuits are provided. In this case, care is taken that the two circuits are de-tuned by a small amount with respect to one another and with respect to the frequency to be amplified. The capacity C_1 with the inductance I_2 then forms one series resonant circuit, whilst the capacity C_2 with the inductance L_1 forms a second series resonant circuit. These two series resonant circuits effect for frequencies which are displaced to quite a small extent in both directions with respect to the frequency to be amplified, channels of low resistance. The result is thereby obtained that the resonance curve of the amplifier in both directions has a very step fall or rise whereby the selectivity of such an arrangement is greatly increased. This circuit is also particularly advantageous in the so-called "single-span" superhets, where very high selectivity is important owing to the high intermediate frequency generally used.

Fig. 20 shows a complete circuit arrangement of a single-span superheterodyne receiver embodying the selectivity arrangements according to this invention.

At the tube A, the series resonant circuit is formed by the coil L_1 and the capacity C_1, while L_2, C_2 constitutes the normal anode tuning circuit. The circuit L_1, C_1 forms a counter-coupling channel, since, of course, it constitutes a considerable resistance for all impulses which do not arrive with its natural frequency, and therefore, for such impulses, like any other resistance inserted in the cathode supply of an ampli-

fier and not bridged-over by condensers or the like, acts as a counter-coupling resistance. However, since the circuit L_1, C_1, of course, cannot be constructed without resistance, a certain resistance also remains for the resonant frequency, namely, the effective resistance of the circuit, and has a counter-coupling effect. This residual resistance deteriorating the resonance properties can be removed by a back-coupling, for instance, between the coils L_1, L_2, which, however, also offers other advantages as regards selectivity and sensitivity.

If this circuit is constructed in a tube which, as is the case, for example, in the intermediate-frequency part of a superheterodyne receiver, generally is to fulfil no other functions than the amplification of this one frequency, this arrangement can be fully utilised.

If, however, it is used in circuits in which an amplified tube or other amplifier unit has to fulfil several functions simultaneously, as is the case, for example, in a mixing tube in a superheterodyne receiver, inconveniences may arise, which may be removed as follows:

As long as the back-coupling L_1, L_2 is not fully utilised, nothing particularly disadvantageous is manifested in a superheterodyne receiver. If, however, it is endeavoured to turn to account the advantages of this coupling to a higher degree by more critical adjustment, an instability is manifested on traversing the receiving wave-range. Investigations have shown that it is attributable to the influence of the second control grid, at which, as is well known, the locally generated auxiliary oscillations are applied. The amplitude of the superheterodyne has not the same magnitude at each oscillation of a traversed wave range and the amplitudes of different magnitude cause a variation of the mean voltage effective at this grid or of the resultant bias of this grid, whereby the steepness in the tube A and, thus, the effect of the back-coupling between L_1 and L_2 is varied.

An attempt, instead of the automatic grid bias production by blocking condensers and grid leak resistances, as is usually employed in the generator of a superhet, to produce a fixed grid bias, for instance by means of cathode resistance or by means of a tapping at a special voltage divider of the anode voltage has a partial success, but is not satisfactory in all cases.

An arrangement which, on the contrary, produces a complete stability even at a very critical adjustment is shown in the form of construction given by way of example in Fig. 20. The oscillator tube B has here a diode path D, which is connected in parallel with the oscillator oscillatory circuit L_3, C_3 and is negatively biased by a battery J. Instead of the battery J, the bias may also be derived in any well-known manner, that is, for instance, by means of a voltage divider from the anode voltage, by special rectification and filtering from an auxiliary winding of the mains transformer or by cathode resistances, also from the mains or other source of anode voltage, or in the case of tubes heated by direct current, also from a source of heating voltage.

The biased diode path D, which could also be replaced by some other biased rectifier, for instance, a "Westector", or by some other current or voltage-limiting arrangement, has the effect that the amplitudes of the circuit L_3, C_3 cannot be increased above the value determined by the diode bias. For this purpose, however, it is desirable to keep the internal resistance of the diode path as small as possible. Likewise, it is desirable to choose the grid bias at the tube B greater than at the diode D. This requirement which is not absolutely necessary, may, however, be fulfilled also by corresponding choice of the transformation ratio at the coil L_3 with respect to its primary winding or similar measures.

In the present constructional example, the core of the coil L_3 is arranged between the poles of an additional magnet M, which enables both the automatic tuning and the remote tuning of the set.

In order to cover as wide a tuning range as possible with a given controlling output at the magnet, it is preferable to give the high-frequency core of the coil L_3 a permeability which is relatively very high for high-frequency cores. This may be achieved inter alia by increasing, under otherwise equal circumstances, the compression pressure in the production of the core, by reducing the thickness of the insulating layers separating the individual core particles, or by somewhat increasing the core-particle size with respect to normal high-frequency coils, although the last-mentioned possibility must not be exaggerated owing to the rapidly increasing damping losses. The use of starting materials of very high permeability, as, for instance, iron-nickel alloys, is also advisable for the same reason both for the magnet and for the core material.

Moreover, the use of these materials for the core and also for the magnet has the further great advantage that these materials are extremely poor in remanence, whereby the calibration error which otherwise frequently arises in magnetic tuning is reduced. It is, however, essential to employ both for the core and for the magnet, materials which have very small coercive force.

As has already been mentioned above, it is a question in the described receiving set of a so-called "single-span" superhet. Instead of sharply tuned preselection circuit coupled to the oscillator circuit mechanically or otherwise, there will therefore be used either, in general, only permanently tuned filters or, insofar as variable circuits are employed, only broadly-tuned circuits, in which an exact observance of synchronism is not important.

In the constructional example of Fig. 20, F is the filter which consists of three T-members. In this case, the inductance of the middle T-member is sub-divided into a primary and secondary winding, which is preferably arranged on a high-frequency mass core. By the sub-division of an alternating current resistance in a filter member, for instance, by sub-division of the mean inductance, it is possible to obtain a favourable matching of the output values of the antenna circuit to the input values of the first tube. Since it is important in superheterodyne receivers and particularly in these with aperiodic input circuits, to avoid as far as possible over-control of the mixing tube, which could produce undesirable combination oscillations by rectifier or modulation action, it is advisable to effect the volume control in the input, even in spite of the use of the negative back-coupling shown here, by cathode resistances, which has a linearising action.

Since, however, in the constructional example of Fig. 20, which shows a set adapted to be remotely operated, a simple regulatable high-ohmic resistance or high-ohmic potentiometer can-

not be used, but a remotely-controllable variable high-ohmic resistance must be used.

In the example given, a tube E is used as input resistance, in which a pure ohmic resistance 121 is used for the regulation. This ohmic resistance is provided with a spring 122, which can be so pressed against the resistance 121 through a lever fixed to a stronger leaf spring 123, that it completely bridges-over the resistance. At heavier or lower pressure exerted by the spring 123, a larger or smaller part of the spring 122 is caused to roll off at the resistance 121, so that the effective value of the resistance 121 is regulatable by the spring pressure 123. The pressure of the spring 123 is determined by a filament 124, which expands more or less on heating and thus, by regulation of its heating current, allows of regulating the effective value of the resistance 121. Instead of a filament 124 there may also be used for resistance regulation in any desired manner a bimetallic strip, which can be electrically heated, possibly, such a bi-metallic strip may be used directly instead of the spring 122.

The regulation of the resistance in the tube E is effected at the operating post by a regulating resistance.

Furthermore, there are also provided in the input circuit a rejector circuit S and an acceptor circuit T. These serve for blocking-out a local transmitter and for preventing the penetration of the intermediate frequency into the input circuit. S and T may also exchange the functions just described. Furthermore, with the existence of several local transmitters, several circuits S or T may also be provided.

The tube A or its anode circuit is coupled with the grid circuit of the tube G by a small condenser, such as a Neutrodon.

It has already been mentioned that the diode path D may also be replaced by a "Westector" or the like; however, it is also to be pointed out that when connecting up such a voltage limiter, an increase in the volume, that is, an increase of the amplifying effect of the tube A is obtained. This volume increase can be particularly observed in a mixing tube of the type of the well-known tube ACH1, is a biased "Westector" is connected in a normal manner to the generator circuit connected to the triode part of this tube.

Instead of connecting the diode or an equivalent element which, as has already been described, is to have as small as possible an internal resistance, to the inductance L_3, the connection, as is shown in Fig. 20 in dotted lines, could also be made to the primary winding of this iron core.

In the tube G there takes place a further amplification and a further selectivity increase, particularly owing to the action of the cathode series resonant circuit L_4, C_4. A choke with a series-connected resistance is connected in parallel with the condenser C4. The resistance serves for producing the grid bias and the choke for keeping high frequency from this resistance. The tube G is provided with three separated lead-in wires, the cathode preferably being separately led out at the top of the envelope or in some other manner at the envelope; likewise, the anode or the grid receives a separate lead at the envelope, while the last of the high-frequency-carrying electrodes, that is, either the remaining control grid or the remaining anode can be led out through the pinch together with the electrodes which are at a fixed potential as regards high frequency. Of course, the cathode could also be led out of the pinch in the normal way and then the grid and anode can be separately led out at the envelope; since, however, it has proved to be preferable to make the capacity of the cathode with respect to earth and other apparatus parts as small as possible, it is sometimes desirable, particularly in the case of amplification of shorter wave-lengths, to lead out the cathode separately in order not to increase still further the capacity which is unavoidable in any case owing to the heater.

On amplification of particularly short-wave currents, it may be preferable specially to dimension the indirectly-heated cathodes substantially in such a manner that the cathodes receive a greater diameter and a smaller length than usual, whereby the capacity between the heater and the cathode itself can be reduced. The linearity of the characteristic which falls owing to the larger cathode diameter under otherwise equal circumstances forms no great drawbacks in the case of use in the intermediate-frequency part of a superheterodyne receiver.

For the rest, however, it is also possible, particularly when amplifying short-wave currents, to supply the cathode heater through the coil of the series resonant circuit. In such a case, the conductor of the coil L_4 would then consist of at least two individual conductors insulated from one another, which may be twisted together. These individual conductors carry the heating current in opposite directions, while they are traversed by the high-frequency currents in the same direction. In this way, iron-containing inductances may also be employed, even with relatively high heating currents, instead of L_4, without modulation phenomena occurring owing to the heating current, since the heating currents, owing to the bifilar effect of the winding, do not result in any magnetisation of the core of L_4.

When using high-frequency strands, different sets of the strands may be used for the supply and return of the heating current. If three sets of high-frequency strands are provided, the third set may be used for earthing of the cathode envelope in the manner of low-frequency, while the other two sets supply the heating input to the filament and remove same. With directly heated tubes, for instance battery tubes, of course, two conductors or sets of conductors are sufficient.

As has already been described, by coupling between L_4 and the corresponding anode circuit inductance, an additional selectivity and sensitivity increase in the case of back-coupling, or a band broadening (selectivity regulation) in the case of counter-coupling can be obtained.

Since a coupling between the anode circuit of the tube G and L_4 would also cause a coupling between the anode circuit of the tube G and the grid circuit of the same tube by capacity between the cathode and control grid, still a further screening grid is provided between these two last-mentioned electrodes. Since, furthermore, for the selectivity-increasing effect of the series resonant circuit lying in the cathode supply lead, the greatest possible steepness of the tube is desired, this additional screening grid is brought to a positive potential with respect to the cathode and acts as space-charge grid, which, however, is not absolutely necessary.

If the "Durchgriff" through this space-charge grid is small, as is, of course, desirable for the purposes of a very effective increase of steepness and screening of the control grid from the cath-

ode, then a large emission current is absorbed by this positive grid. Since it is not rational to derive this large emission current, which in a constructed model with a very low Durchgriff through the space-charge grid amounts to a value up to 20 milli-amperes, directly from the anode voltage source, since otherwise a large portion of output in series resistance must be neutralised, which not only unnecessarily loads the anode current source, but, what is important, for instance, particularly in mains sets, also very heavily pre-loads the filter means associated with anode voltage and thus necessitates more expensive filter means, it is advisable in such a case to derive the space-charge grid current from a point before the anode side of the filter means, particularly before the anode current mains choke. There may then be connected directly behind the rectifier tube a resistance which produces the necessary potential drop, in order to reduce the anode voltage, which of course amounts normally to several hundred volts, to an amount of about 10 to 20 volts.

Since rather high resistances are necessary for the reduction of this voltage resistance and since on the other hand, at voltages of only 10 to 20 volts, very cheap electrolytic condensers can be used without danger, as is usual, for instance, for bridging the cathode resistance, the filtering produced by this resistance and the said condensers is usually already sufficient. If necessary, two or more of such resistance capacity members may be connected in series in order to produce a higher degree of filtering.

If no particular safety precautions are provided, it is advisable in such a case, however, to heat the rectifier tube indirectly, in order to prevent excessive voltages from arising, on heating the tube cathodes, at the electrolytic condensers of the space-charge grids. If economy in current consumption is important, the space-charge grid voltage may be derived from a separate rectifier. In this case also, the expenditure on additional filter means is not very great, since for very small means at the low voltages employed, high capacities in the form of electrolytic condensers are available, so that as further filter means, possibly resistances suffice, but at least only very small inductance are required. In such a case, the rectifier tubes which supply the anode tube may possibly be provided with an additional auxiliary electrode possibly arranged at a smaller distance from the cathode.

In the constructional example of Fig. 20, however, there is used for the feeding of the space-charge grids of the intermediate-frequency tubes G and H another method which can be carried out entirely without additional expenditure of energy for the feeding of the space-charge grids. Here, the potential drop is used, which in any case is necessary in order to bring the cathode of the loudspeaker tube to a higher potential by the grid bias of this tube.

Modern loudspeaker tubes require, as is well-known, rather high anode currents. Thus, for example, the well-known speaker pentodes, type AL4, works with an anode current of 36 to 40 milli-amperes, to which the screen-grid current is added, so that in the cathode resistance producing the grid bias, a current of about 45 milli-amperes flows. Since the space-charge grids of the tubes G and H, as already mentioned, may each have 10 to 20 milli-amperes current absorption and since, furthermore, their voltage may be about 4 to 10 volts positive with respect to the cathode, then by suitably dimensioning, the grid bias of the final tube on the one hand, and the space-charge grid voltage and space-charge grid current of the high-frequency tubes, on the other, the output otherwise to be neutralised in the cathode resistance of the final tube may be advantageously utilised here for the feeding of the space-charge grids. The bridging-over condenser K, which is existent in any case, together with a further condenser N preferably also constructed as an electrolytic condenser, and a decoupling resistance or a de°coupling inductance O take care that the low frequency from the cathode circuit of the final tube is kept away from the space-charge grids. If necessary, the space-charge grids of the two tubes G and H may also be coupled with one another.

If at P a potentiometer or other voltage regulator is inserted, then by means of the space-charge grid voltage, an additional regulation of the amplification or back-coupling in the tubes G and H may be effected, which, since a volume control by the tube E is already existent, can either be utilised on replacement of the manually operated potentiometer P by an automatic arrangement, for automatic volume control or, alternatively, by variation of the back-coupling in the circuits of the tubes G and H, may also be utilised for manual or automatic band width regulation. For the rest, of course, the tubes G and H may, however, also be used, particularly on suitable construction of their control electrodes, as normal exponential tubes (hexodes) for a manual or automatic regulation at the control grids.

The alternating voltage amplified by the tube G is transferred through a blocking condenser to the grid of the following amplifier tube H. The arrangement at the tube H corresponds substantially to that of the tube G. Only the series circuit in the cathode supply lead is coupled here through a transformer. The cathode is at first connected for direct current again to the negative anode voltage pole through a resistance producing the grid bias, and a choke constituting a high resistance for the high frequency to be amplified.

Connected in parallel with this branch is the primary of a high-frequency transformer Q in series with a condenser, which "blocks" the direct current, so that the resistance connected in the parallel branch for grid bias production is not short-circuited. On the secondary side there is connected to the transformer the series resonant circuit L_5, C_5, which is again so tuned that it constitutes as high a resistance as possible for all frequencies with the exception of the resonant frequency (intermediate frequency of the receiver).

Of course, the condenser C_5 must not be so small and the inductance L_5 must not be made so large that the stray capacities already constitute an essential short-circuit path to the resistance formed by the series resonant circuit in the non-resonance case, since otherwise the purely ohmic resistance of the circuit L_5 C_5 existing in the resonance case is unnecessarily increased.

The transformer Q is so dimensioned that the conditions existing in the circuit L_5, C_5 are transferred almost without alteration to the cathode circuit. It is preferable to dimension the inductance L_5 or the condenser C_5 for low voltages, since then the stray capacities, of course, are negligible in their action, and to produce the required high-ohmic action in the non-resonance case merely by transformer matching with the aid of

the winding ratio at the transformer Q in the cathode circuit of the tube H.

This is advisable, however, only if the circuit L_5, C_5, exactly as has been described in the case of the tube G, is used only for the purposes of the selectivity increase or sensitivity increase.

In the case of the tube H, however, the series resonant circuit L_5, C_5 together with the rectifier tube R is also used for automatic tuning control. Since high voltages are desired for this case at the circuit L_5, C_5, the series resonant circuit itself is to be used here with a small capacity and large inductance.

In itself, for example, when using "Westectors" or the like rectifiers, it would be possible to obtain the regulating voltage by rectification also directly at a series resonant circuit inserted in the cathode supply lead of a tube. If, however, a normal diode is employed, then in this case the cathode-filament capacity may be disturbing and then it may be advisable to excite the series circuit through a transformer, in order that the resting potential of the circuit L_5, C_5 can be chosen at will. The increased losses caused by the transformer coupling can be compensated to the desired degree by a back-coupling indicated, for instance, by the double arrow shown in dotted lines.

However, even if, as is shown in the Figure by way of example, the series resonant circuit is not directly connected in the cathode supply lead, but is connected thereto by transformer, particularly attention should be paid to the capacitive conditions, since already small irregularities may disturb the clearness of the resonance position. The centre of the series resonant circuit, that is, the point of connection between L_5 and C_5 is connected to the diode cathode, which in turn may be earthed for high frequency through a condenser.

Since the parallel capacity to the series circuit inter alia is not to be too large for the reasons set forth above, relatively small condensers C_6 and C_7 are provided for the coupling of the diode path. Since these small condensers, moreover, are connected in series with one another with respect to the series circuit, the disturbances by these condensers may be kept small.

If resonance exists between the intermediate frequency coming into action at the circuit L_5, C_5 and the natural frequency of the circuit, then at L_5 and C_5 equal voltages arise and the resistances W_1 and W_2 are therefore traversed by equal but oppositely directed currents. Since, in the present case, an increased time constant is no drawback and the circuit L_5, C_5 is to be loaded as little as possible, the resistances W_1 and W_2 are preferably chosen as very high-ohmic resistances.

Since the centre of the series resonant circuit is at earth potential as regards high frequency and the difference of the voltage values at the resistances W_1 and W_2 is to be employed for controlling the tube U, that is, must be conducted outwards, then further resistances W_3 and W_4 are provided, which in the manner of high frequency, preserve the symmetry of the circuit L_5, C_5 with respect to earth or the other apparatus parts, but, on the other hand, allow of supplying the difference of the voltages at W_1 and W_2 to the grid of the tube U.

Preferably, the tube U receives a negative bias which, in a manner well-known per se, can be produced by any method known according to the state of the art, from the heavy current supply feeding the apparatus. No particular negative grid bias is, however, shown for the tube U.

In the anode circuit of the tube U, the winding of the magnet M is provided, which by pre-magnetisation of the corresponding high-frequency core allows of influencing the inductance of the coil L_3. If a frequency now impinges on the circuit L_5, C_5, which departs from the theoretical frequency, then, according as to whether the wave length is greater or smaller than the theoretical frequency, a different voltage will arise at C_5 or L_5 and, therefore, the control grid of the tube will be more or less negatively biased. By this means, a smaller or greater anode current is driven through the winding M and thereby the frequency of the oscillator circuit is decreased or increased until the theoretical frequency is practically again existent in the circuit L_5, C_5.

The small residual remanence still existing for the magnet M and the core of the coil L_3 has the effect, in this case, on favourable dimensioning of the amplification factor of the tube U and of the other elements, that by this automatic sharp-tuning arrangement, a very complete correction of tuning errors is effected.

In addition to the automatic tuning correction, however, the magnet M serves simultaneously for the remote operation of the set. To this end, the screen-grid voltage of the tube U is made variable by the potentiometer V. The potentiometer V in this case should be imagined to be arranged at the place of operation, in the same way as the regulating resistance X used for the volume control. These circuit elements were not arranged separately from the corresponding tubes merely for the sake of clearness.

In order, when operating the potentiometer V, to prevent a drawing phenomenon of the tuning which is caused by the action of the automatic sharp tuning, a switch Y is provided which short-circuits the automatic tuning device when the potentiometer V is operated. The elements V and Y may be positively connected together, so that an operation of the potentiometer automatically puts the automatic tuning correction means out of action.

In order to make the tuning or tuning indication at the potentiometer V independent of possible fluctuations of the current sources, a glow discharge stabiliser Z is provided, from which the screen-grid voltage of the tube U is derived. The tube U is so dimensioned that by traversing the resistance of V with the current tap, the entire wave-range of the receiver can be utilised.

The cathode circuit of the tube H is therefore utilised here with the aid of the series resonant circuit not only for the obtaining of a selectivity increase, but also for the purposes of an automatic tuning correction.

As already mentioned above, it may be preferable for the purpose of economy of space-charge grid current, to divide the function of the first grid employed in the tubes G and H, which grid at the same time causes the screening between the control grid and cathode and a space-charge removal, and to provide a separate space-charge grid and cathode screen-grid. In this case, the separate space charge grid can then be particularly advantageously employed as an auxiliary anode for a direct current amplification, while the particular cathode screen-grid can be used as a control grid of the direct current regulating operation. The two grids can easily be kept at

zero potential as regards alternating current by blocking condensers and other de-coupling means, so that then such a tube performs two functions without being constrained in any way to concessions and compromises, which are otherwise necessary in reflex circuits.

The low-frequency voltages produced at the last-discussed diode are now supplied in the loudspeaker tube or in the loudspeaker tube unit (according to whether the two tube systems I and II are arranged in a common tube envelope or not), which consists of two systems connected in series. Such series-connected systems have, as has also already been set forth in a prior application of the present Applicant, similar characteristics to screen-grid tubes or pentodes, in which case, however, the series-connected tube systems present the advantage that it is unnecessary to arrange a particular collecting grid in order to remove secondary emissions of the upper grid acting as screen-grid and in which case, furthermore, practically a negligibly small output is received by the upper grid, whereas, as is well-known, the output consumption of the screen-grids of normal multi-grid tubes may be very considerable.

These advantages result in extremely high rectilinearity of the characteristics and, thus, slight distortions, as can hardly be achieved in pentodes.

The present invention can also provide advantages for transmitters or transmitter amplifiers.

It has been found that a substantial progressive advantage when using such circuits in a transmitter is the immunisation from higher harmonics. It is well-known to use additional filter circuits for the filtering-out of higher harmonics in transmitter circuits. For this purpose, chiefly parallel circuits have hitherto been employed. According to the present application, one or more series circuits are to be employed for the achievement of the said object. Fig. 21 shows a construction by way of example in a self-excited transmitter. **131** is the tube of the transmitter with the control grid **132**, the anode **133** and the cathode **134**. In the cathode supply lead a series resonant circuit is inserted, which consists of the coil **135** and the condenser **136**. In parallel with the condenser **136** a choke coil is provided which serves for supplying the direct current.

The tuned anode circuit **137**, **138** serves for coupling to the radiating antenna **139**. The back-coupling for generating the oscillator oscillation can be carried out in any desired manner. In the present constructional example, a back-coupling between the coils **135** and **138** is used for oscillation generation. This has the advantage that the grid **132** remains at a steady potential as regards high-frequency, and any modulation currents can be supplied to this grid without regard to any high-frequency voltage. However, all other well-known methods of modulation may also be employed.

In Fig. 22, the arrangement of the series resonant circuit **135**, **136** in a transmitting amplifier is shown in a further constructional example. The oscillator produces here an oscillation in the oscillatory circuit **141** which, through the coil **142**, transfers the oscillation to the control grid of the tube **143**. The tube **143** is essentially a high-frequency transmitting pentode but, moreover, has an additional grid **144**, which effects a screening of the control grid connected to the coil **142**, against the cathode.

This screening grid **144** is not absolutely necessary, but is preferable. It may receive according to the dimensioning and the construction of the tube, a positive voltage, in which case it simultaneously exerts a space-charge grid effect, or the grid **144** may have cathode potential, or it may have a negative potential with respect to the cathode.

The grid **144** or a further auxiliary grid arranged at this point or elsewhere may be used for impressing a modulation. In addition to the grid **144**, a second grid would then be provided between the cathode and control grid.

From the antenna circuit **145** the amplified oscillation is then transmitted to the antenna circuit **147** through a coupling condenser **146**. The antenna may be adjusted by a variometer **148** to exact resonance with the transmitted oscillation. Since here also the series resonant circuit **135**, **136** again produces a strong counter-coupling at all oscillations which do not coincide with the natural wave of the series resonant circuit, all the disturbing oscillations, but particularly for instance, overtones, which might disturb, are separated out, and therefore the effect is obtained which otherwise is obtained by special filter means for suppressing harmonic oscillations, without appreciable losses having to be involved, since the circuit **135**, **136** constitutes for the desired useful oscillation a practically negligible resistance, which corresponds only to the effective resistance of this circuit, which resistance is to be kept small.

Since a quartz crystal electrically corresponds to a series resonant circuit, that is, a circuit having very small capacity, then according to a feature of the invention, the series resonant circuit is constituted by a quartz crystal.

Fig. 23 shows a constructional example of this idea of the invention. The idea of the invention is illustrated here in a remotely-controlled set, the control quartz being situated in the cathode circuit of the tube II. The quartz itself with its holder is denoted here by **201**. Since the static capacity of the quartz with its holder would constitute a parallel path for the undesirable oscillations, this parallel capacity is tuned out by a coil **202**, which is preferably made variable. The tuning-out has the effect that the static capacity of the quartz and of the support as well as the remaining stray capacities together with the coil **202** form an oscillatory circuit, which is tuned to the oscillations to be received. Connected in series with the coil **202** is the resistance **203**, bridged over by a parallel condenser, which resistance serves for producing the grid bias. This resistance **203**, it is true, damps the oscillatory circuit **201**, **202**, but this is not detrimental in the present case, since the oscillatory circuit **201**, **202** of course is to serve for tuning out undesirable frequencies. Its resonance curve becomes so broad owing to the resistance **203**, that, for all frequencies which are at all still amplified by the anode circuit **204** of the arrangement, an effective blocking in the cathode lead is produced, which is only interrupted by the narrow frequency band, which the quartz crystal **201** passes. Since the selectivity of the quartz crystal is extremely great, that is, the band which is passed by it is only very narrow, an extremely selective receiving set can be produced in this manner.

If the reception of speech or music is to be provided for, which, as is well-known, requires a certain band width for its transmission, then in principle two methods can be used: either the in-

termediate frequency of the receiving set may be placed so high that also the frequency band passed by the quartz is broad enough to reproduce speech and music well, or by the damping of the quartz, a broadening of the band passed is effected.

This damping can be effected either by enclosing the quartz in pressure gas or in a liquid which consumes a part of the oscillating energy by friction losses, which can be effected, for example, by enclosing the quartz in small ampules, or the quartz may be electrically damped. For the purpose of the electrical damping, resistances may be connected in series or in parallel with the quartz, these resistances being either effective resistances or reactances. As reactances, preferably series or parallel resonant circuits are employed which are connected either in parallel or in series with the quartz and which may be suitably back-coupled or counter-coupled with the corresponding anode or other circuit of the amplifier. It is then possible, by varying the coupling or by varying the tuning of such circuits, to vary the quartz damping or the band width passed, so that a set with variable band width is then obtained in a simple manner.

In itself, the method described here is, of course, applicable to any type of receiver. However, since the quartz, of course, only permits a variation of the received wave-length on quite a small scale, it is necessary to insert the quartz in a circuit which, in operation, does not vary its tuning even on the reception of different transmissions. From this results the preferable use of the superheterodyne principle.

In Fig. 23, therefore, the apparatus is constructed as a superheterodyne receiver, it being a question here of a superheterodyne receiver with remote tuning by the influencing of premagnetisable coils, but it is to be readily understood that any other type of superheterodyne receiver may also be employed.

The input circuit of the superheterodyne receiver consists of the coil **205** to which the antenna circuit is also coupled at a tapping, as well as the rotary condenser **209**, which serves for the adjustment of the wave-range as well as for the approximate establishment of synchronism between the input circuit and oscillator circuit. The oscillator circuit is formed from the coils on the core **206** and the condenser **210**. The cores **205** and **206** consist of a Ferrocart-like material, it being, however, preferable to give these in a manner described above, a somewhat higher permeability than is otherwise usual for high-frequency cores. The cores are situated between the poles of two magnets **207** and **208**, the magnetism of which can be varied by a regulatable magnetising direct current for the purpose of the tuning of the set. The receiver is arranged in a manner well-known per se, with the aid of the diode VII and the circuits **211** and **212**, which are somewhat detuned in opposite directions with respect to the intermediate frequency, for an automatic tuning correction. The difference voltage arising at the resistances **213** and **214** issued in a manner well-known per se for the regulation of the automatic correction of the tuning, this difference voltage being effective at the grid of the auxiliary tube VI.

In the anode circuit of the tube VI, the exciting windings of the two magnets **207** and **208** are inserted in parallel connection. The anode voltage for the tube VI may be derived at the operating post through the slide **215** from the resistance **216** which therefore acts as potentiometer. The resistance **216** is connected, on one hand, through a smaller resistance **217** to the negative pole of the anode voltage source, while, on the other hand, it is connected through the lead **218** to the positive pole.

A certain difficulty in a remotely-tuned set resides in obtaining a suitable and cheap arrangment for remote volume-control. In itself, it would be obvious to provide for the high-frequency amplifying tubes, that is, in this case, for the tubes I and II, an exponential characteristic, and to effect the volume control by means of a more or less strong bias. However, this is difficult to carry out when the set, as is frequently required in modern sets, is to be provided with an automatic volume control, for which then the said two tubes are employed while utilising an exponential characteristic.

In the present case, therefore, for this purpose, the tube III is employed which is a duo-diode-triode, that is, a tube which is relatively cheap and, owing to the simultaneously existing two diode paths, can be employed both for automatic volume control and for demodulation. The control grid of this tube is connected here through a blocking ocndenser direct to the oscillatory circuit **204**. The oscillatory circuit **220** is inductively coupled to the anode circuit of the tube III by means of the coupling coil **221**, and in normal tubes, for instance, a coupling ratio of 1:5 to 1:10 is advisable.

Between the two circuits **204** and **220**, an electrostatic screen **223** is provided, which may consist, for instance, of a number of parallel earthed wires arranged close to one another and has the effect that the two circuits **220** and **204** can be inductively coupled together, without appreciably influencing one another capacitively.

In this way, a neutralisation of the capacitive coupling within the tube III, which, of course, is not a screen-grid tube, can be obtained, in which case this neutralisation must only be taken so far that an adequate elimination of damping is effected in the circuits **204** and **220** in order to compensate for the damping produced at these two circuits by the connected diode paths. This damping compensation serves here primarily for obtaining a large amplification, since, of course, provision is made for an adequate selectivity by means of the quartz crystal **201** and the tuning circuits **204**, **220** and **222** do not have to produce the main selectivity, which is already achieved by the crystal **201**, but merely provide for the remote selectivity. In dimensioning these circuits, therefore, an extremely small capacitive resistance and a very large inductive resistance can also be used, so that a very large dynamic resistance and thus a high amplification results.

Should the amplification be affected by excessive damping of the circuit **222**, then here a remedy may be provided by back-coupling this circuit with the series resonant circuit in the cathode, as is indicated by the curved arrow, while the circuits **220** and **204** are, of course, undamped by mutual coupling.

By means of the resistance **217** at the operating post and the corresponding slider, the bias for the tube III may be made negative to such an extent that practically no more sound comes through, whereas, on the other hand, by reduction of the negative bias, the back-coupling condition can be reached, that is, the set can be adjusted to maximum volume and sensitivity.

In order to make the automatic volume control independent of the adjustment of the volume at the operating post, the diode is connected for the volume control direct to the circuit **204**.

In order that the back-coupling between the circuit **222** and the corresponding cathode circuit shall not be influenced by variations of the oscillator voltage, the oscillator voltage is limited by a diode in the tube V. This is effected by negatively biasing the particular diode path by means of a biasing battery **225** or other source of bias, that is, no damping of the circuit whatsoever is caused, as long as the oscillator voltage does not exceed the bias. If, however, the amount of the bias is reached, then from this point onwards the diode path acts practically as a short-circuit and thus prevents a further increase of the voltage, so that the oscillator voltage is kept constant over the entire range.

The second diode path of the tube V is also connected to the oscillator voltage through a relatively large blocking condenser **226** and a choke coil **227**. The choke **227**, with respect to which the capacitive resistance of the condenser **226** is negligible, forms together with the capacity of the corresponding diode path a member dependent upon frequency, so that at the corresponding diode path a voltage is effective which is merely dependent on the frequency of the oscillator. This voltage is rectified and produces at the resistance **228** a direct current voltage, which acts through the resistance **229** on the grid of the tube V and therefore controls the anode current of the tube V in accordance with the oscillator frequency, so that the instrument **224**, which measures the current of the tube V, can be calibrated in frequencies.

It has already been mentioned above that it is preferable for the dimensioning of the series resonant circuit, which is to be situated in a counter-coupling channel, that is, for instance, in the supply to the cathode of an amplifying tube, to make the capacity of this circuit as small as possible in order to obtain as small a band width as possible.

As mentioned above, however, in amplifiers, for example those which work according to the principle of grid control, any desired reduction of the tuning capacity of the series resonant circuit lying in the cathode supply, or of a corresponding four-pole, which may then, of course, consist of a larger number of capacities and inductances, is not possible because the stray capacities themselves already become equally large particularly at a certain minimum value of the tuning capacity, and then a reduction of the tuning capacity can practically bring no further advantages.

In Fig. 12, the conditions which arise, in particular, at very small tuning capacities C_1, are pictorially illustrated. E is here the common earth lead or an equivalent zero lead of the apparatus and K the cathode, in the supply of which the said tuning circuit is to lie. L_1 is the tuning inductance.

It is now found that, in the first instance, two kinds of stray capacities are existent, firstly, the capacity C_2 shown in dotted lines, which therefore primarily constitutes the stray capacity between the cathode and that end of the coil L_1 which is connected to the cathode, with respect to earth, and, furthermore, the stray capacities C_3 and C_4. If the stray capacity C_2 becomes rather large this means that, in addition to the path through L_1 and C_1, a further parallel path to the cathode is existent, and it is apparent that the selective properties of the circuit L_1, C_1 must become ineffective if the parallel path C_2 receives such a small resistance in relation to the resistance provided by the actual tuning elements themselves, that this last-mentioned resistance is useless for the operation of the apparatus.

This drawback may then be obviated, as has already been mentioned above if there is connected in parallel with the capacity C_2 a coil L_2, preferably a variometer, and the inductance of this variometer L_2 is varied until this coil together with the stray capacities is tuned to the desired frequencies.

Since the selectivity of the arrangement is already roughly produced by the usual anode circuit or grid circuit tuning means and the tuning of the stray capacity C_2 and the coil L_2 is effected to the same frequencies as those of the said selection means, the following case is then given: By the said tuning means on the anode or control-grid side, only a certain frequency band is, in general, conducted to the arrangement, and substantially the same frequency band is tuned out again by the counter-coupling resistance, which is formed by the tuning means C_2, L_2, so that, if only this capacity C_2 and L_2 were provided, practically nothing at all is amplified.

It is seen that the pass range of the amplifier is now exclusively determined by the tuning of L_1, C_1, and it should be assumed that no difference whatever exists any longer in making C_1 as small as may be desired. This is no true, however, owing to the stray capacities C_4 and particularly C_3.

These two last-mentioned stray capacities lie in parallel with the actual tuning capacity C_1, and it is obvious that therefore the tuning capacity C_1 can never be made smaller than the value which is determined by the capacities C_4 and particularly C_3. Practical experiments have shown that the smallest effective value of C_1 which can be obtained in this manner lies at approximately 2–4 cms. capacity. These values are just sufficient to obtain in a tube with sufficient steepness, even at 1600 kilocycles, band widths which lie at about 10 kilocycles or even less. The adequate steepness may also be obtained, regardless of the fact that the geometrical arrangement of a normal tube is correspondingly chosen, by utilising a space-charge grid effect, as has also already been described.

However, cases may arise where it is undesirable to use tubes of such high steepness and, moreover, it would also be desirable to reduce the band widths materially, since then the possibilities arise of obtaining in the short-wave range substantially more favourable selectivities than hitherto. This may also be valuable for the ranges in longer waves, since, for instance, an apparatus according to the so-called "single-span" supernet principle can then be constructed, which receives a very high intermediate frequency and yet is sufficiently selective.

It is shown in Fig. 25 how this can be carried out. This figure corresponds substantially to the arrangement of Fig. 24, except that a screen S_1 is also provided over the tuning circuit L_1, C_1 or at least over the coil L_1. This screen is shown in chain-dotted lines, whereby it is to be indicated that it is not made of solid material, but that for many cases, particularly when the coil L_1 is to couple to some other coil, it is preferable to make it of a wire network of parallel wires or the like, so that an electrostatic screen-

ing takes place, but an inductive coupling with another coil is possible.

If this screen S_1 were now connected to earth potential, the conditions would not be improved but worsened, since, of course, the stray capacity of the coil L_1 towards earth is then further increased. The screen S_1 is therefore kept at cathode potential, as indicated in the drawing. All stray lines of force which issue from the coil L_1 and would otherwise discharge on the earth lead E are then intercepted by the screen S_1 and, therefore, an increased capacity of the coil L_1 towards the cathode side develops, which, however, as is to be shown in the following, is not detrimental for the present purpose.

Seen from the cathode side, the two stray capacities C_5 and C_6, which correspond to the first-mentioned stray capacities C_3 and C_4, now no longer lie in parallel with the condenser C_1 but in series with this condenser. Since, however, a series connection of condensers, as is well-known, always has a smaller capacity than the smallest individual capacity of the series circuit, it is now possible to adjust any small capacities with the condenser C_1. With respect to the inductance of the coil L_1, the stray capacities C_5 and C_6 cause an apparent inductance increase, which can be compensated by suitable dimensioning of the coil L_1.

Since, as has already been previously pointed out, it is absolutely necessary that the screening should be as complete as possible between the individual circuits whilst the coil L_1 shall be capable of coupling, for the purpose of the neutralisation of existent residual couplings or for obtaining a removal of damping or the like, to the anode circuit coil or grid-circuit coil, the difficulty arises that owing to the screen S_1, which is, of course, at cathode potential, a capacitive coupling could arise towards a further coil, with which the coil L_1 is to be coupled. In order to avoid this, a further earthed screen S_2 is arranged at some distance from the screen S_1. By the two screens S_1, S_2 or by the mutual capacity of these two screens, which, if it becomes very disturbing, can of course be reduced by arranging the two screens at a somewhat greater distance from one another, no drawback is generally obtained, because the capacity of the two screens S_1, S_2 to one another is, of course, only connected in parallel with the stray capacity C_2 which exists in any case, and can be tuned out by corresponding adjustment of the variometer.

The variometer L_2 may, in this case, be of a very simple construction. Usually, ordinary honeycomb winding coils which are variable in their relative position are sufficient. Therefore, for example, a fixed coil may be provided, with respect to which a second coil may be moved, towards or away from it, by means of a spindle or the like. The two coils constituting the variometer L_2 need not be of particularly damping-free construction, since it may be favourable, if the band tuned out by the tuning means L_2, C_2 is rather broad, whereby the tuning is then little critical.

As great a dynamic resistance of the tuning circuit C_2, L_2 as possible is also unnecessary, since a dynamic resistance of 10 to 20,000 ohms is already sufficient to suppress amplification practically completely.

On the other hand, a large damping again has the advantage that possibly a particular subsequent correction of the tuning at the coil L_2 or at a small tuning condenser connected in parallel with the capacity C_2 is no longer necessary. For this reason, it may be preferable to wind the coil or the coils L_2 from very thin or resistance wire, in which case then this high resistance or this relatively high resistance of the coils L_2 presents the additional advantage that it can be used for producing a certain direct current potential drop, which produces the grid bias of the control grid with respect to the cathode K.

An example of a constructional arrangement of the individual parts in an arrangement according to Fig. 25 is given by Fig. 26. L_1 is here again the tuning winding of the series resonant circuit, which in the present constructional example is arranged on a double-T-shaped coil of high-frequency iron. Such a high-frequency iron may be, for instance, the well-known H-core made of "sirufer." The iron core of the coil L_1 projects through corresponding recesses in the two plates P_1 and P_2 in such a manner that thereby the coil core undergoes a firm support within a Bakelite tube R_1. The Bakelite tubes R_1 and R_2 are fixed to corresponding recesses of a metal plate T_1. The metal plate T_1 has a tubular extension which projects through the screen S_3, which is earthed and may represent the screening wall of some screening box or the like. By means of a spring F_1, the plate T_1 is pressed against the screening wall in such a manner that it can be rotated about the tubular member passing through the screening wall S_3.

Between the two friciton discs S_4 and S_5, which are resiliently pressed together, the tapered edge of the plate T_1 is gripped in such a manner that, by rotation of the driving wheel A, the whole body containing the tuning core with winding L_1 can be rotated about its axis, whereby a variable coupling can be obtained between the coil L_1 and the coil L_5, which may belong to the anode circuit or any other circuit of the receiver.

One end of the coil L_1 is connected to the plate T_2, which in turn is connected by a screened lead L_6 to the cathode. The other supply lead to the coil L_1 terminates at the pin *St*. This pin forms together with the metal tube R_3, which is fixed to the drive Tr_1 a capacity which corresponds to the capacity C_1 in Figs. 24 and 25 and can be varied in its value by more or less screwing-in of the drive Tr_1.

The tube R_1 carries at its outer side a wire spiral S_1 which preferably has a medium pitch. The winding preferably has a free end and is connected also to the plate T_2 and one feeding end of the coil L_1 or through the lead L_6 to the cathode of the tube, and corresponds to the screen S_1 in Fig. 25. The large pitch of the coil S_1 prevents it having an appreciable inductance. If, however, the whole apparatus is intended for the reception of rather short waves, or if it is a question of short-wave transmitting apparatus in which the inductance also of a coil of large pitch could already lie within the resonance position of other constructional elements, then it may be advisable to provide, instead of a coil, only individual wire rings on the tube R_1, which may possibly be slotted and all electrically connected together by a transverse lead and connected to the plate T_2.

Likewise, the tube R_2 also carries a wire coil S_2 which is constructed substantially in accordance with the wire coil S_1, but is electrically connected to the plate T_1 instead of T_2.

If desired, a quartz stage in a cathode circuit may be combined with cathode circuits in other

amplifier stages, which are constructed in accordance with the above details, since the advantage of a cumulatively-acting selectivity increase is then obtained, without necessitating several exactly equal quartzes which as is well-known, can only be manufactured with extreme difficulty.

This can also be used for the construction of the well-known quartz filters, in which therefore several circuits are coupled together by a quartz acting as series circuit. As is well-known, a variation of the band width in such quartz filters is possible by varying series or parallel resistances or varying the tuning of the coupled circuits. The advantage just mentioned then exists, however, that the selectivity figure of a single quartz stage is no longer sufficient and several such stages would have to be provided for obtaining the required high selectivity. However, this is again difficult because exactly equally tuned quartzes can only be made with great difficulty. A remedy may be provided here also by means of an arrangement according to the application.

One stage of a quartz filter with a normal oscillating quartz may be designed again as coupling member of the two circuits, which are usually tuned circuits, and the remaining stages of the whole amplifier are then provided with series resonant circuits instead of quartzes, said series resonant circuits being designed after the fashion of the arrangements described in Figs. 24, 25 and 26.

If it is a question of relatively large band widths, which are to be transmitted, then the use of an ordinary series resonant circuit as coupling member between the individual circuits of the filters or as coupling member between two tuning circuits of the filters is possibly sufficient; if, however, small band widths are to be obtained, then the parallel capacities according to Fig. 24 and possibly also other stray capacities according to Fig. 25 must be tuned out.

As has already been pointed out on several occasions, the arrangements described here are not restricted to receiving circuits, but can of course also be applied to transmitters of any circuit owing to thin selectivity-increasing effect.

In transmitters, in particular, the removal of the higher harmonics by such means will often be very desirable.

Fig. 27 shows such a filter in simplest construction, the same references as in Figs. 24, 25 and 26 having been used for the coupling member between the two main circuits constituting the filter.

As has already been mentioned, the obtainable band width depends not only upon the choice of the capacities C_1 in Figs. 24, 25 and 26, but also upon the steepness of the tube employed. If, therefore, at a given adjustment of the oscillating circuit in the cathode supply lead, for instance, a band width of about 5 kilocycles is obtained, if the tubes have full steepness, then, of course, on regulating down the steepness, for instance, by means of an automatic volume control, which may then be effected by more or less large negative grid bias at the control grid or at another negative grid, or, alternatively, which may be effected by variation of the positive bias, say, at the space-charge grid, simultaneously also the band width is regulated. If the instantaneous steepness is small, then the band width is automatically increased. This effect arises when, by means of the automatic volume control, in the case of the existence of loud signals, the sensitivity is regulated back. It is therefore found that, here, without substantial additional means, a very effective automatic band width regulation can be achieved if only one automatic volume control is provided.

The selectivity curve of the receiver or of the amplifier (if the latter is not arranged in a receiver but in a transmitter or the like) may, moreover, be varied at will. It has already been stated that instead of a simple circuit, four-poles, which consist of a larger number of circuits, may be employed. In addition to this method, there is moreover yet another, simpler, method of obtaining, for instance, a resonance curve flattened at its peak.

If, by choice of the anode circuit and the tube data, the result is obtained that in the case of resonance the tube or the anode coupling resistance is over-matched, the following remarkable phenomenon occurs: As long as the anode circuit resistance is small as compared with the internal resistance of the tube, the steepness of the tube at different frequencies may be assumed as constant, independently of the anode circuit. If, however, owing to the fact that the resistance of the anode circuit is made very high for the desired frequency, which can be achieved, for instance, by back-coupling of the anode circuit and/or by making the capacity of the anode circuit small in proportion to the inductance and, furthermore, by making the internal resistance of the tube also relatively small, the result is obtained that in the case of resonance the anode circuit coupling resistance becomes large in proportion to the internal resistance of the tube, then in the case of resonance a considerable reduction of the effective steepness occurs, that is, the statically measured steepness is reduced by change-over to a dynamic steepness of substantially lower value. However, since, on the other hand, as has been pointed out, the steepness of the selectivity curve caused by the series resonant circuit or the like in the cathode lead is dependent upon the tube steepness, that is, upon the effective tube steepness, it follows from this that at the flanks of the curves, that is, at points which depart to some extent from the resonance value, a great steepness will exist, whereas directly at the resonance point, at which the dynamic steepness of the tube is small owing to the high anode resistance, the steepness of the resonance curve is flattened, which then results in a characteristic of the nature of a band filter. In this case, these values may be adjusted at will by varying the bias at the control grids or even by varying the positive voltage at the space-charge grid or by some other voltage variation.

Since the tube has at least two grids, at which such voltage variations may cause deformations of the resonance curve, a grid, for instance, the control grid, which may undergo a formation after the fashion of an exponential tube, may serve for automatic selectively regulation, whereas, for example, the voltage variation at the space-charge grid may cause a manual selectivity variation. For the correct working of such an automatic or manual selectivity regulation, it is desirable that the band width of the selection means connected on the anode side shall be substantially broader than that of the selection means arranged in the cathode supply lead.

Since, moreover, in most cases, an additional back-coupling is provided between the circuit in

the cathode supply lead and, for instance, the anode circuit, the first-mentioned effect can be further extended and increased by a variation of the voltage at these grids. If the instantaneous steepness of the tube is great, then a strong back-coupling action also occurs, which still further increases the resistance of the anode circuit, whereas with tubes regulated down, the anode circuit of the tube is also reduced in its resistance by the reduced back-coupling. It is seen that, therefore, this action may be utilised both as an increase of the regulating capacity for the volume control and for assisting the automatic selectivity regulation.

If, in the constructional examples hitherto discussed, screened cathodes were usually mentioned, this is a consequence of the arrangement of the counter-coupling oscillatory circuits in the cathode supply lead. If these counter-coupling circuits are not provided in the cathode supply lead, that is, if special counter-coupling channels are arranged, which lead to special control grids, then these particular control grids themselves must be screened from the other grids and from the other tube parts by screening electrodes; therefore, all that has been said for the cathode construction can then be applied accordingly to these other electrodes.

On the other hand, if the cathode capacity C_2, that is, the stray capacity in Figs. 24 to 26 is tuned out by an auxiliary inductance L_2 or the like, the cathode itself may be constructed with somewhat higher capacity than is otherwise expedient, since, of course, an increase of the stray capacities is no longer so dangerous. Therefore, in this case, the separate leading-out of the cathode supply lead at the envelope itself may be disregarded, and the cathode may be led out as usual through the pinch. But, of course, in spite of this, if the oscillatory circuit is provided in the cathode supply lead, a sufficient screening against the other electrodes must be used. For the purpose of pure regulation, as is usual, for instance, in hexodes, there may also be provided in the tubes further grids for supplying regulating voltages, which may then simultaneously take over the function of screen-grids.

As has already been previously pointed out the screening of the cathode is necessary chiefly when, as is usual in a cascade amplifier, the grid circuit and the anode circuit as well as the circuits used in the cathode for increasing selectivity are tuned to the same frequency. If, however, the frequency to which the grid circuit of a tube is tuned is not identical with the frequency to be amplified, as may be the case, for example, in the mixing tube circuits of the superheterodyne arrangement, in which case, of course, the grid circuit of the mixing tube is tuned to the frequency to be received but not to the intermediate frequency to be amplified, this screening may in some cases be dispensed with.

In this case, however, another peculiarity is to be observed. In particular, in those mixing tubes which, moreover, contain a triode system for the production of the local oscillator oscillation, but also in the other ordinary mixing tubes according to the multi-grid system, a certain capacity exists between the cathode and that grid at which the oscillator oscillations arise or are applied. However, since the cathode, in the circuits discussed here, usually does not have earth potential, but is at high-frequency potential owing to the oscillatory circuit situated in the cathode supply, then through this capacity disturbances are easily initiated between the grids carrying the oscillator oscillation and the cathode, which disturbances are manifested as undesirable accompanying phenomena. These phenomena act particularly detrimentally when the tuning circuit located in the cathode supply, that is, for example, the series circuit L_1, C_1 is back-coupled with the corresponding anode circuit which in itself, of course, causes an increase of the amplification and selectivity.

In this case, on adjusting the oscillator oscillation, which is necessary, of course, when tuning transmitters or receivers, a self-oscillation of the circuits may suddenly be caused. To avoid this, either the electrodes carrying an oscillator voltage, particularly the oscillator grids, are to be screened against the cathode, or the detrimental capacity must be compensated by a neutralising circuit. The neutralisation can be carried out, for example, in such a manner that opposite the cathode point, still further windings are provided on a coil body, which is connected on one side to the cathode itself, and there is derived from these additional turns a neutralising voltage which is also connected through a regulatable neutralising capacity to the cathode.

Since, in this case, no particular adjustment of a neutralising point is necessary, the screening of these electrodes from the cathode by the arrangement of additional screens and screen-grids is still more favourable. These screen-grids, if it is expedient for the process of amplification in the tube, may reecive a positive potential in order to act in this way as a space charge grid or actual screen-grid.

They are to be earthed as regards alternating current by the arrangement of capacities. In this way, usually, the detrimental base capacities cannot be removed and, therefore, in such cases, it is also expedient to lead out these grids separately at the tube envelope.

Reference will now be made to the particular circumstances, the consideration of which is important, if it is desired to utilise counter-coupling channels for the obtaining of selective properties. In particular, this applies in the use of tuning means, as, for instance, series resonant circuits in the cathode supply lead of amplifying tubes.

When, in the present application, however, amplifier tubes were mentioned, this expression is by no means intended to cover here only the incandescent cathode vacuum amplifiers most customary at the present day, but is to be applied accordingly to all other types of amplifiers; in particular, all amplifiers based, for instance, on the principle of electron multiplication as well as gas or vapour-filled amplifiers are also to be covered thereby. An arrangement, which in the present case, for instance, is preferably arranged in the cathode supply lead, does not necessarily have to be provided in such a case also in the cathode supply lead.

As will be shown further below, e. g. when using tuning circuits, say series resonant circuits, in the cathode supply lead of a pentode-like tube or multi-grid tube constructed in some other manner, particular advantages result owing to the fact that this circuit is traversed by the sum of all the emission currents which pass to the main anodes and also to the auxiliary electrodes. Therefore, on suitable application of the subject of the invention to electron multipliers, it may be preferable in such a case to arrange a similarly-acting circuit not in the cathode supply lead,

which, of course, in this case, carries the lowest current intensity, but in the circuit of the last anode or in a circuit which is traversed by the currents of individual or a number of auxiliary anodes, which already carry greater currents.

Returning to the case of an amplifying tube constructed according to the aspects usual at the present day, if we observe the effects arising owing to a series resonant circuit which is inserted in the cathode supply lead, the following is to be observed. If the tube employed is a triode, then a relative voltage variation between the cathode and control grid, no matter how this voltage variation occurs, will result under otherwise equal conditions in equal controlling actions. Therefore, in such a case, if at first the simplified assumption is made that the voltage difference between the cathode and anode is kept constant, it is immaterial whether the cathode potential is kept constant and the control grid potential is varied by a certain amount, or whether the control grid potential is kept constant and the cathode potential is varied by the same amount with respect to the control grid potential.

If, on the contrary, we consider, for example, a pentode in usual connection, it is by no means material whether merely the potential of the control grid is varied with the cathode kept constant or whether the control grid potential is kept constant and the cathode potential is varied by the same amount.

Whereas in the case of the cathode kept constant there arises merely owing to the variation of the control grid potential a controlling action which was hitherto generally utilised for amplifying purposes, there arises, on the contrary, if the control grid potential is kept constant and the cathode voltage is varied by the same amount, a considerably greater control action which is explained by the fact that also the other electrodes of the tube, for instance, the screen-grid and collecting grid also exert in such a case an additional controlling action, since, of course, they are kept at fixed potential already by the use of the well-known circuits.

Therefore, if the cathode alters its potential, for instance, by 1 volt, then not only a relative voltage variation of 1 volt occurs between the cathode and control grid, but at the same time there also occurs an equally large voltage variation, controlling in the same sense, between the cathode and screen-grid and cathode and collecting grid, so that the total alteration of the emission current of the cathode at an alteration of the cathode potential by the same amount is much larger than if only the control grid is altered while the cathode is kept constant.

Since the selectivity-increasing effects of a tuning circuit arranged in the cathode supply lead, for instance, a series resonant circuit are due to the fact that, owing to the potential drop occurring in the cathode supply lead, the cathode carries out voltage fluctuations relatively to the other electrodes of the tube, it is seen that when using multi-grid tubes, the effects of such a circuit can be extremely increased.

It is furthermore known that with the aid of the principle of the space-charge grid tube by the production of virtual cathodes, which can be brought near to the controlling cathodes, extreme steepnesses can be obtained. Such a case of a control of a virtual cathode exists, however, e. g. in a normal pentode already with some approximation, if the cathode potential is varied relatively to the potential of the other electrodes. Between the screen-grid and collecting grid, a potential threshold develops which may act as virtual cathode, particularly on favourable dimensioning of the tube. Now, if the voltages at these electrodes are suitably chosen, the result can be obtained that on varying the cathode potential by two such successive auxiliary electrodes with a high potential difference, quite considerable additional steepnesses with regard to the control by cathode potential fluctuations can be achieved. In this case, for example, the collecting grid or other electrodes may perhaps be connected with the cathode.

It is therefore particularly preferable, in arrangements which work with negative back-coupling for the purpose of increasing selectivity and particularly with negative back-coupling by tuning means in the cathode supply lead (or accordingly in the anode or auxiliary electrode supply lead, for instance, in electron multipliers) to use tubes which have potential thresholds after the fashion of those existing between the screen-grid and the collecting grid of a pentode, in which case it is favourable that, as e. g. in an hexode or octode, several such potentiometer thresholds follow one after the other and it is furthermore favourable in such a case to adjust the voltages between these successive electrodes in such a manner that virtual cathodes forming high steepnesses are formed with cathode potential fluctuations.

What is said here for multi-grid discharge vessels also equally applies to such discharge vessels or discharge system arrangements in which a plurality of discharge vessels or discharge systems are employed in series connection (see, for example, tube I and tube II in Fig. 20) in order to obtain similar effects as in multi-grid tubes.

In the above, different types of counter-coupling have been shown, but it is to be pointed out that the existing possibilities are not exhausted thereby and that according to the particular problem which happens to arise, it may be preferable to choose any other type of counter-coupling instead of that shown, in which case by selection means inserted in the counter-coupling channel, either desired frequencies may be selected from a frequency mixture or undesirable frequencies in a frequency mixture may be suppressed.

Fig. 28 shows an alternative arrangement employing ammeters or voltmeters for giving indication of the adjusted frequency in magnetically tuned receivers. The circuit L3 C3 and the diode D correspond to those shown in Fig. 20.

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Fig. 1.

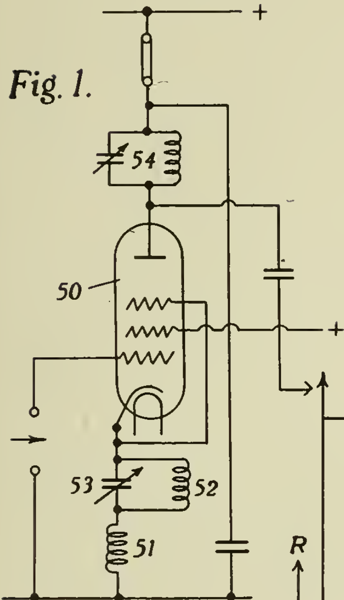


Fig. 2.

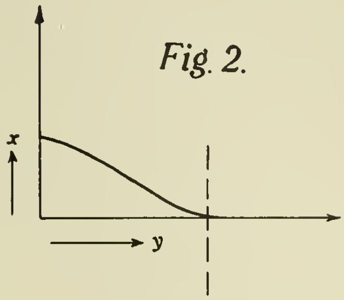


Fig. 3.

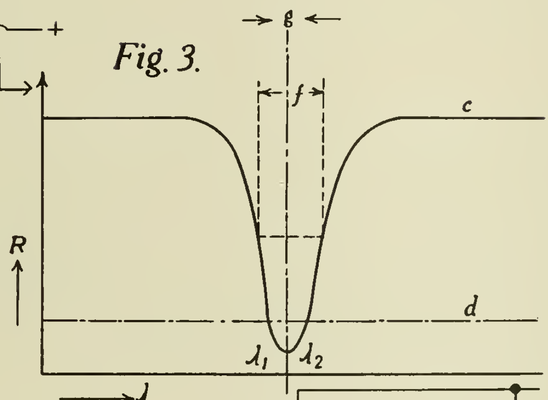


Fig. 4.

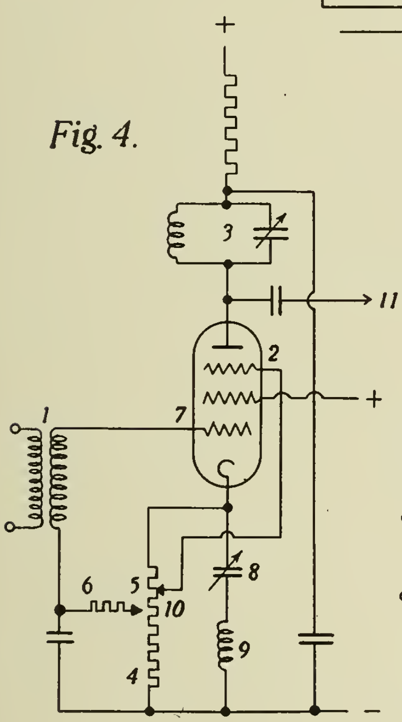
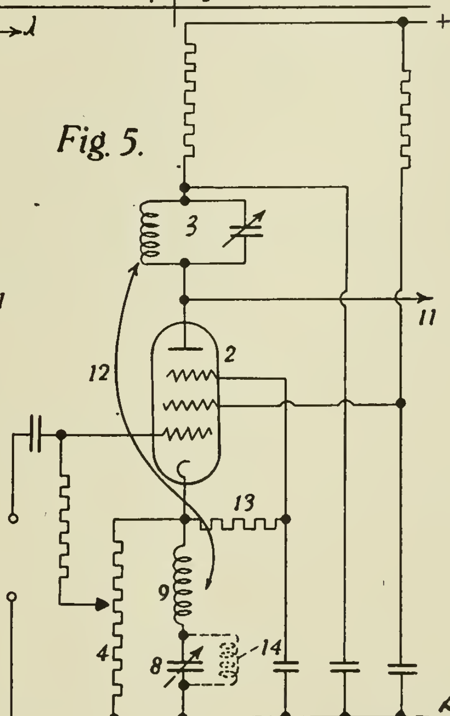


Fig. 5.



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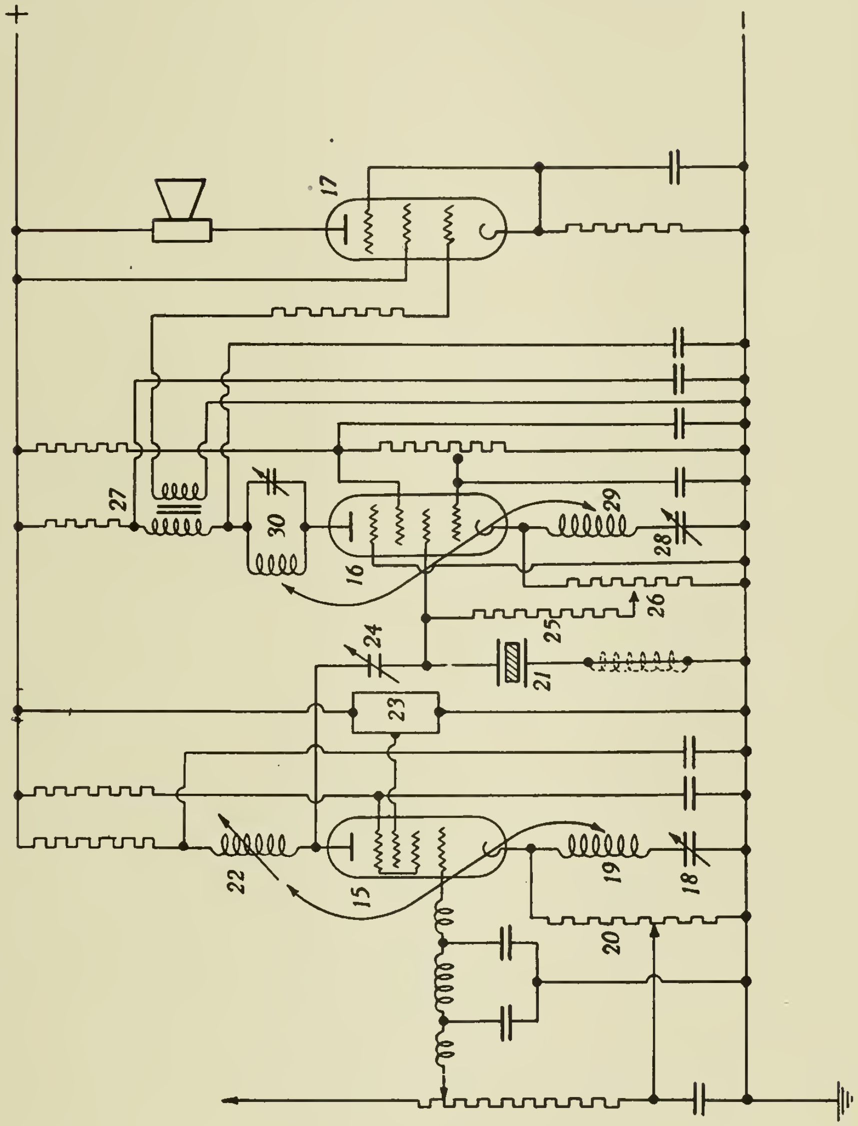

Fig. 6.

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Fig. 6.

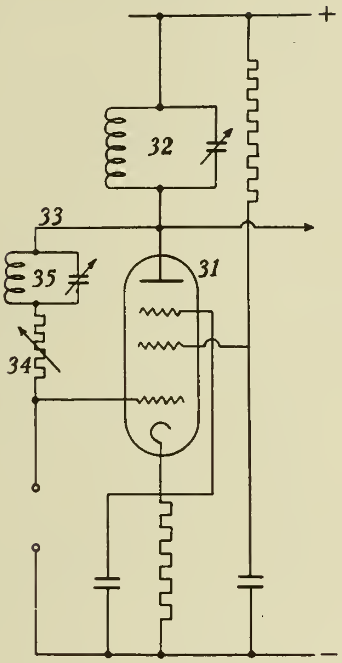

Fig. 7.

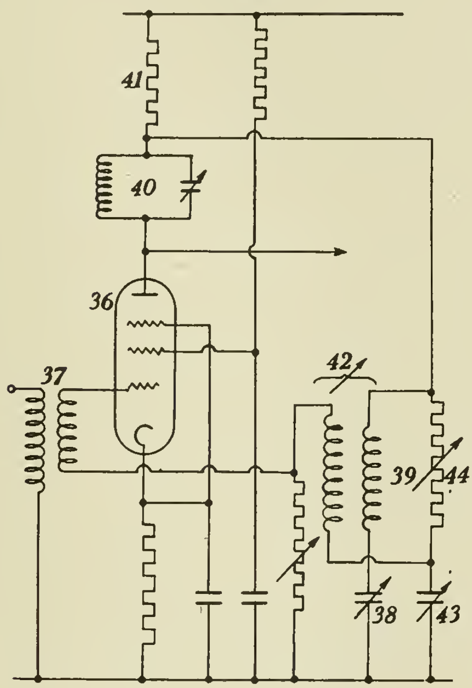

Fig. 9.

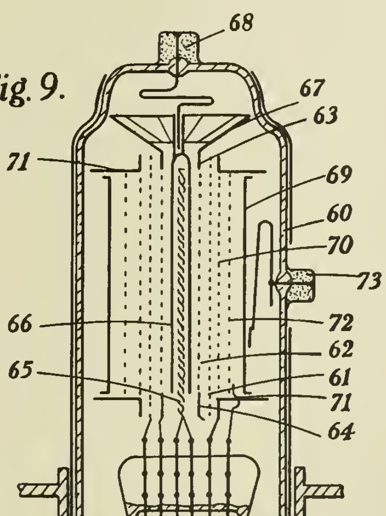

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Fig. 10.

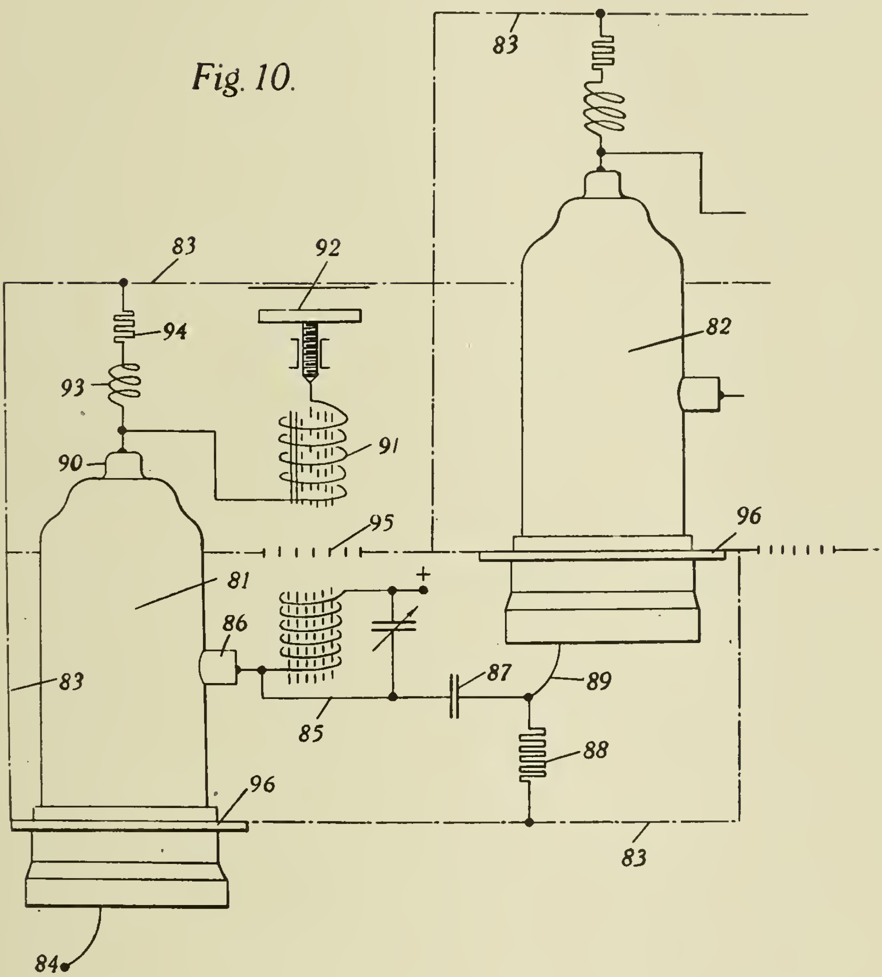

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Fig. 11.

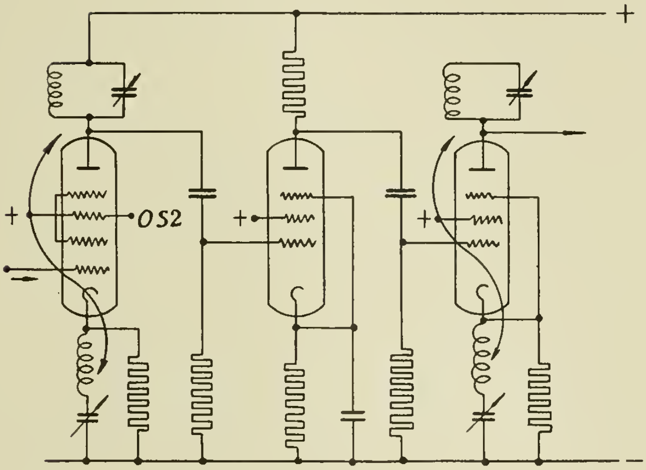

Fig. 12.

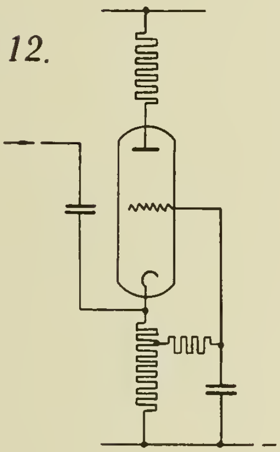

Fig. 13.

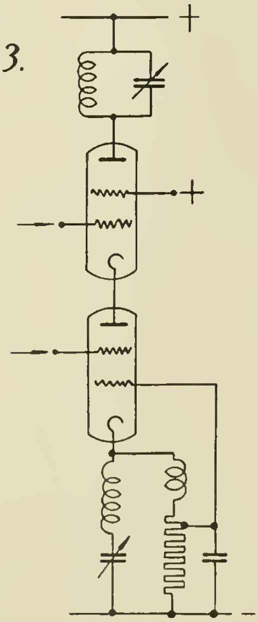

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Fig. 8.

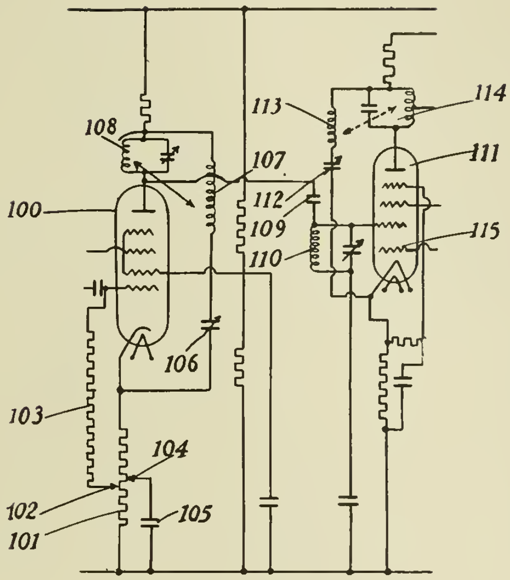

Fig. 9.

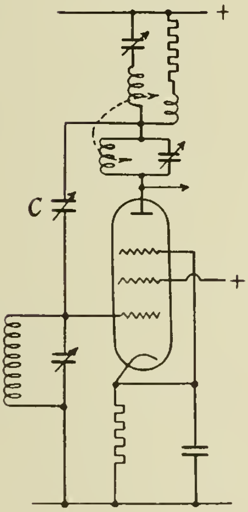

Fig. 10.

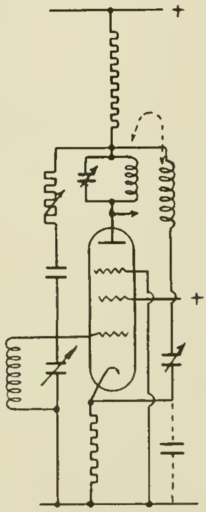

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Fig. 17.

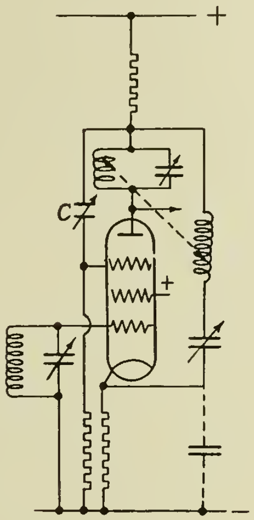

Fig. 19.

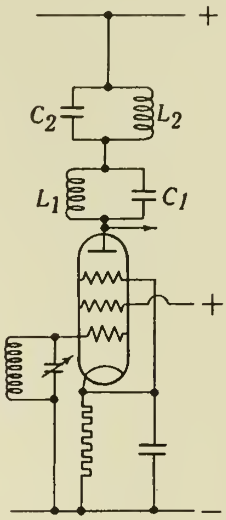

Fig. 18.

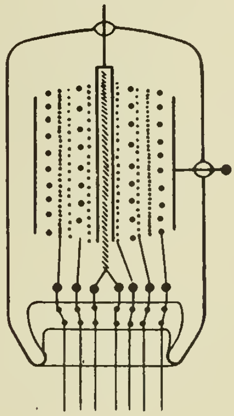

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Fig. 20.

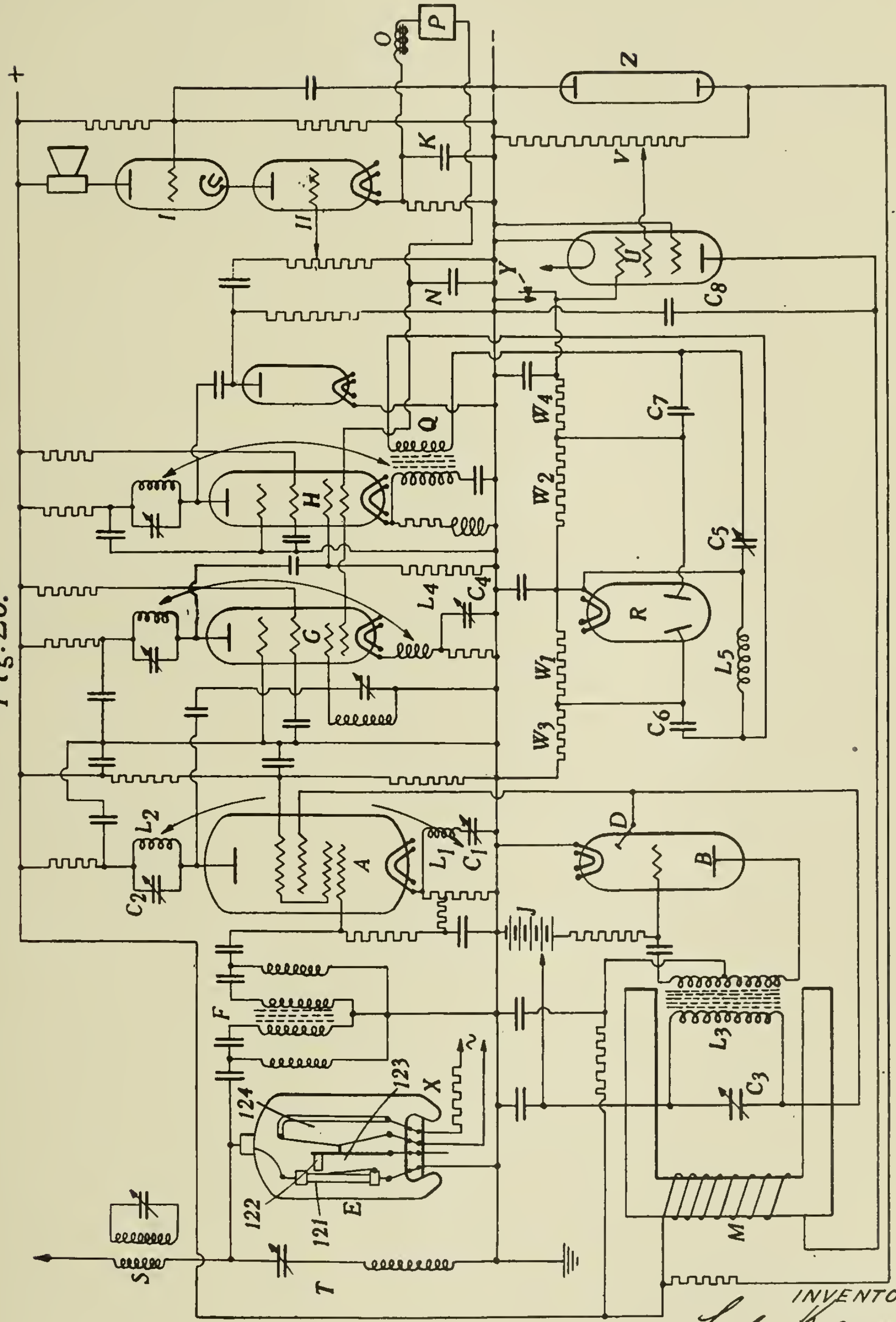

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Fig. 21.

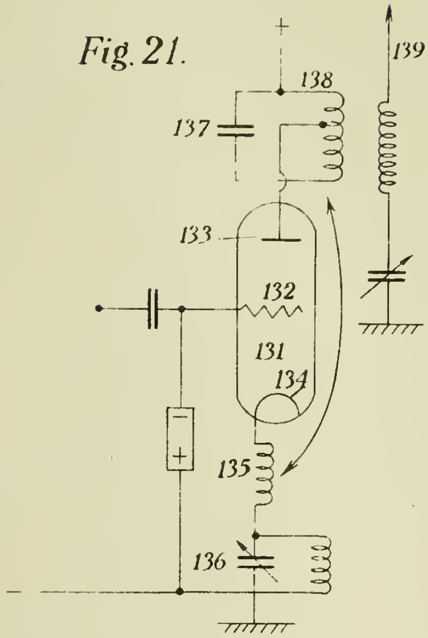

Fig. 22.

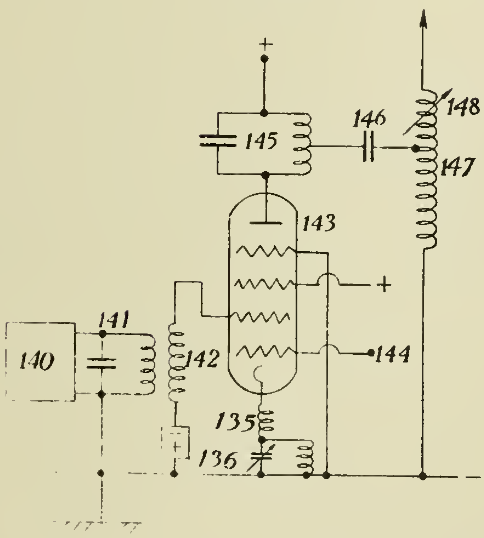

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Fig. 11.

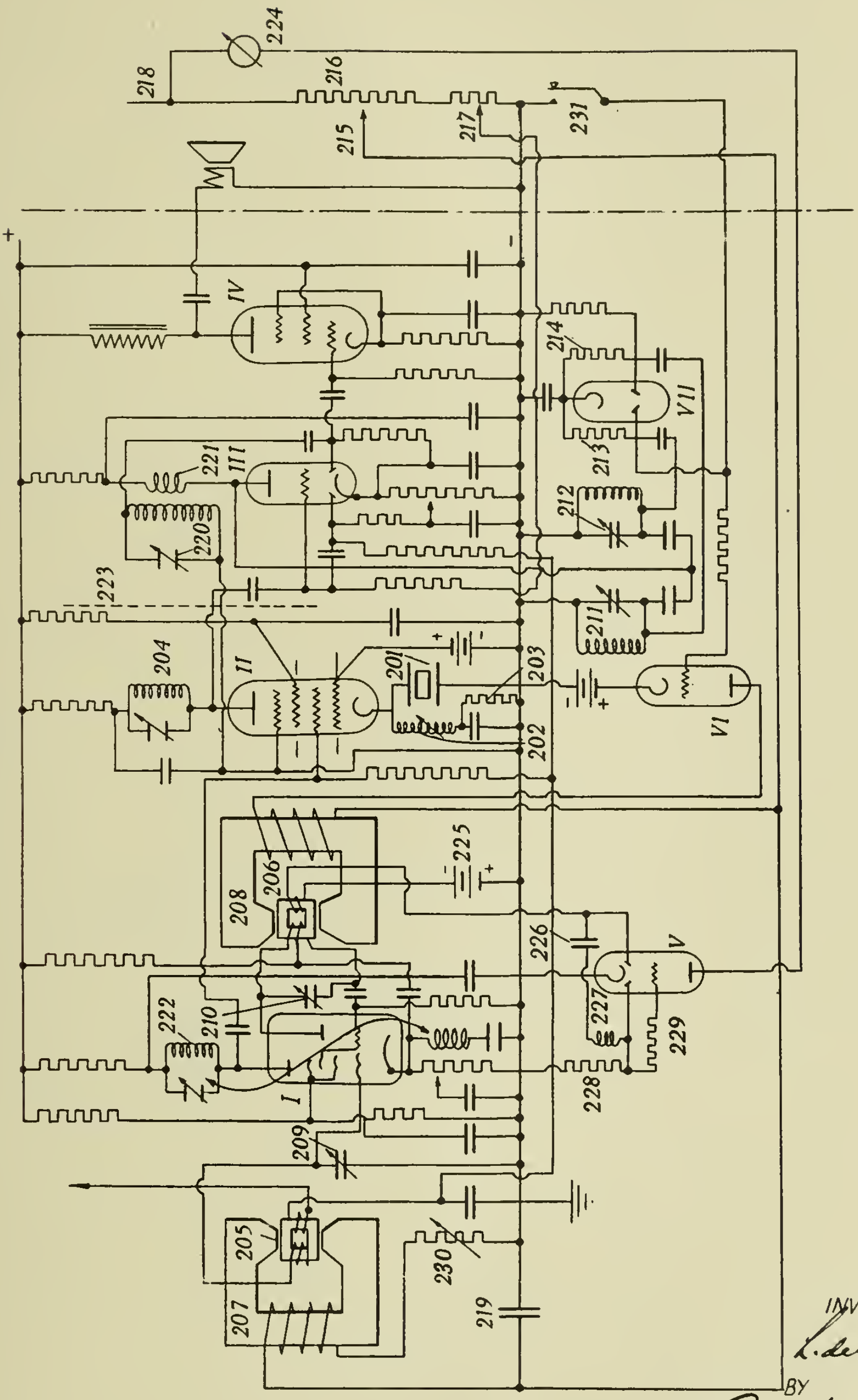

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Fig. 12.

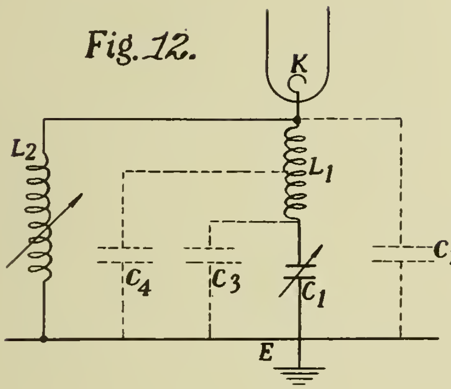

Fig. 13

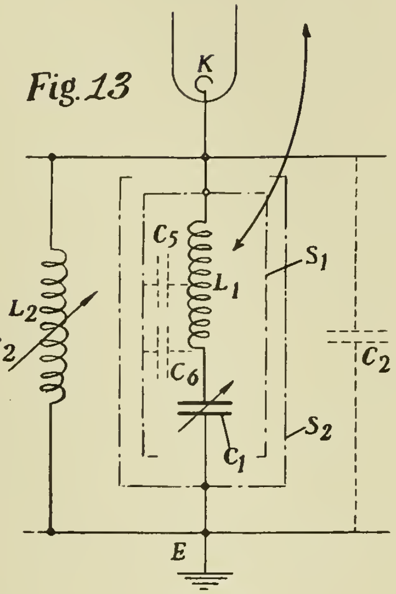

Fig. 14.

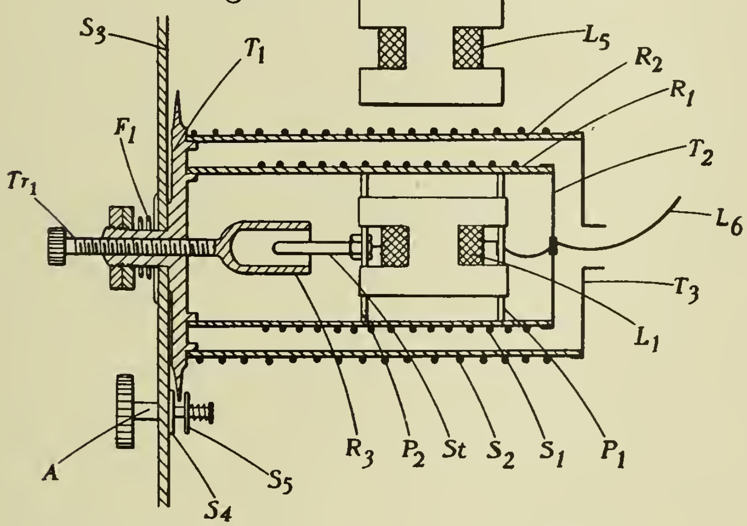

Fig. 27.

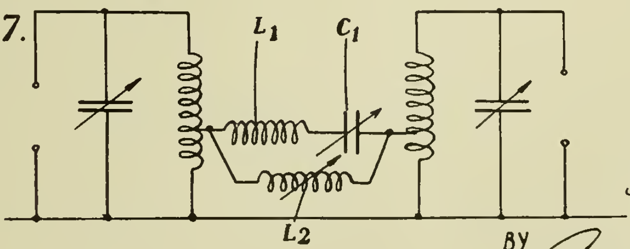

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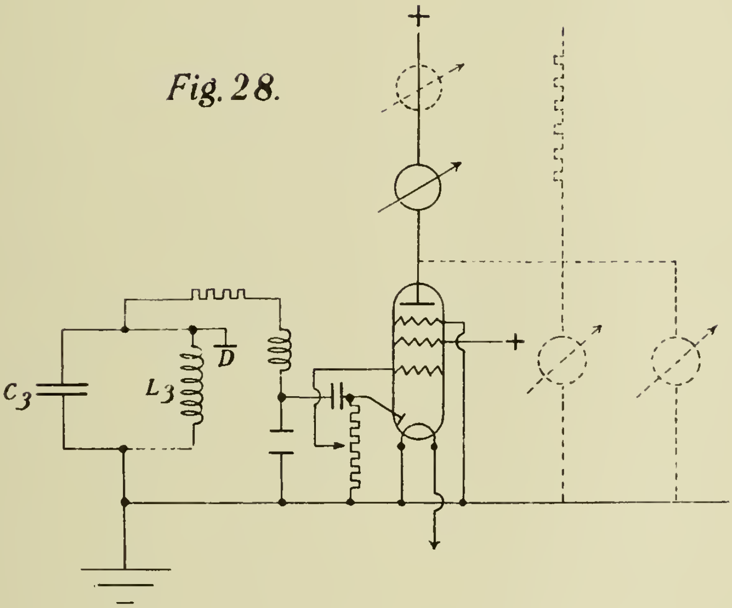
Fig. 28.



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ALIEN PROPERTY CUSTODIAN

CALCULATING MACHINES, CASH REGISTERS OR THE LIKE

August Friedrich Pott, Zella-Mehlis II, Thuringia, Germany; vested in the Alien Property Custodian

Application filed December 29, 1937

This application is a continuation of my applications Ser. No. 35,546 and 83,751 and relates to calculating machines, cash registers or the like having totalizers moved by the paper carriage for the simultaneous calculation of all the denominations of a multi-denominational value.

In these machines, as is known, totalizers of different width are used and are disposed as required on the carriage. The actuating mechanism, therefore must have a number of actuator segments and type-printing rods corresponding to the widest totalizer.

When a narrow totalizer is located over the actuating mechanism, no difficulties are encountered in holding the actuator segments lying to the left adjacent the totalizer in their rest position since they were not set from the keyboard for any movement.

On the contrary difficulties are encountered in total-taking, since in this case only those actuators need be operated which stand opposite to the operative totalizer and within the width of this totalizer only those actuator segments which stand opposite to the denominations containing a value.

These difficulties were attempted to be overcome in calculating machines in which the drive of the type-printing members in the setting direction was effected by spring power, by incorporating in the machine a locking mechanism which was released in dependence upon the totalizer in the working position by a control member arranged on this totalizer so that only the denominations of the actuator mechanism were released which correspond to the number of the denominations of the totalizer in the working position. In these totalizers, however, no means were provided for automatically preventing errors in total-taking due to the totalizers being incorrectly set through inattention or mistake on the part of the operator. These devices, moreover, were unsuitable for overcoming the difficulties in machines in which both the forward and backward movements of the totalizer actuating members and of the type-printing rods were effected positively.

According to the invention these difficulties are overcome in this type of machine also, by providing for each totalizer a zeroizing device operated preferably by a power drive and by taking totals by this zeroizing device. By this construction the provision of a locking mechanism is dispensed with so that the building of the machine is simplified. Also, with this arrangement security is provided against incorrect settings.

In the drawings, one example of construction of the invention is represented.

Figure 1 shows a front elevation of the machine.

Figure 2 shows a side elevation of the arrangement of the adjusting and indicating wheels as well as of the keyboard, viewed in the arrow direction **286** of Fig. 1 according to the section line II—II.

Figure 3 shows an elevation in perspective of the friction clutch coupling taken from the left hand front of the machine.

Figure 4 shows a perspective elevation of the escapement taken from the left hand front of the machine.

Figure 5 shows a side elevation of the keyboard according to the section line V—V of Fig. 6 and viewed in the arrow direction **286** of Fig. 1 in which view the mechanisms are located in the rest position. The left hand side wall of the machine is removed for the sake of clearness.

Figure 6 shows a plan of the keyboard in which the cover plate and the base plate are removed for the sake of clearness.

Figure 7 shows a plan of the machine in which the printing mechanism, the adjusting and indicating wheels, the zeroizing mechanism for the adjusting and indicating wheels and different other parts are illustrated while the cover plates and the paper carriage are removed for the sake of clearness and in which different mechanisms are not illustrated in order to disclose others.

Figure 8 shows a plan of the coupling mechanism arranged on a plate fixed to the motor housing and located in the rest position according to Fig. 7 in an enlarged scale.

Figure 9 shows a side elevation of the coupling mechanism according to Fig. 8, whereby only the parts are illustrated, which are lying on the right hand side of the plate.

Figure 10 shows a side elevation of the coupling mechanism according to Fig. 8, whereby only the parts are illustrated, which are lying on the left hand side of the plate.

Figure 11 shows a section of the drive coupling viewed in the arrow direction **286** of Fig. 8 and along the section line XI—XI.

Fig. 12 shows in perspective a detail of Fig. 9.

Fig. 13 shows in perspective a detail of Fig. 10.

Fig. 14 shows a side elevation of a section according to the section line II—II of Fig. 1 and viewed in the arorw direction **286** in which view the printing mechanisms and the adjusting and

indicating wheels are located in the rest position. The right hand wall of the machine is removed for the sake of clearness.

Fig. 15 shows a perspective elevation, viewed from the left hand front of the machine, of the arrangement of the adjusting and indicating wheels as well as the mechanisms which return the adjusting and indicating wheels to their rest position, in which view different parts for the sake of clearness are represented drawn out from one another.

Figure 16 shows a plan of the machine in which is illustrated the invention and in which the cover plates and the paper carriage are removed for the sake of clearness. Different mechanisms are not illustrated in order to disclose others.

Figure 17 shows a plan of the coupling and driving mechanism in an enlarged scale.

Figure 18 shows a side elevation according to Fig. 7 with the cover plate removed, in which only the mechanisms are illustrated which are arranged in front of the left hand side wall of the machine, the view being taken in the arrow direction **286** of Fig. 1.

Figure 19 shows a side elevation of the coupling mechanism for the register of a section according to the section line II—II of Fig. 1 and viewed in the arrow direction **286** in which view the mechanisms are located in the rest position. The right hand side wall of the machine is removed for the sake of clearness.

Figure 20 shows a side elevation according to Fig. 19, in which view the arrangement of the resetting device is illustrated.

Figure 21 shows a side elevation of the coupling mechanism for the total taking mechanism the view being taken in the arrow direction **286** of Fig. 1.

Figure 22 shows a perspective elevation, viewed from the left hand front of the machine, of the arrangement of the couplings, in which view different parts for the sake of clearness are represented drawn out from one another.

Figure 23 shows in perspective a detail of Fig. 16.

Figure 24 shows a perspective elevation, viewed from the left hand front of the machine of the arrangement of the resetting device, in which view different parts for the sake of clearness are represented drawn out from one another.

Figure 25 shows a longitudinal section according to Fig. 24.

Fig. 26 shows a perspective detail of Fig. 19.

Figure 27 shows a side elevation of the resetting shaft is shown in its home position.

Fig. 28 shows likewise a side elevation of the resetting device according to Fig. 24 in which view the resetting shaft is shown in an intermediate working position.

Figure 29 shows a further side elevation of the resetting device according to Fig. 24 in which view the resetting shaft is shown in the working position, in which the resetting process is just brought to an end.

For the sake of a better understanding of the present invention it seems advisable to briefly set forth the operation of said machine as described in the copending application Nr. 14,898 under the headings "General description," "Setting up of a value into the adjusting and indicating wheels," "Operation of the drive for the adding and printing mechanism," "Operation of the printing mechanism," and "Retraction of the adjusting and indicating wheels to their right hand position."

General description

On the front of the machine the keys **1** which are marked from "1" to "9" (Fig. 7) and the key **2**, which is indicated by "0" are arranged. Above the keys **1** and **2** the inspection aperture **3** (Fig. 1) for the indicating mechanism is disposed. On the right hand side of the machine the addition key lever **4**, the multiplication key lever **5** and the total key lever **6** are arranged. The forwardly directed end of the addition key lever **4** is bent upwards (Fig. 10) and the free upwardly directed end again bent off at right angles to the left is provided with the marking "Add." The forwardly and upwardly directed free end of the key lever **5** is bent off at right angles to the right and provided with the marking "Mult." The free forwardly directed end of the key lever **6** is provided with a key **8**, which is marked with "T" (Fig. 7). Further a motor **9** (Fig. 1) is removably attached on the right hand side of the machine. The rotations of the motor **9** are transferred through a worm **10** (Figures 8 and 9) and a worm wheel **11** to a driving shaft **12**. The motor **9** is switched in by means of a handle **13**, which is likewise arranged on the right hand side of the machine. On the rear side of the machine the paper carriage **14** (Fig. 1) is arranged. On the paper carriage **14** as many totalizers as desired of different widths are arranged on a totalizer attaching rail **15** (Fig. 14) in Fig. 1 only three totalizers **16**, **17** and **18** are illustrated) and in the present case by way of example the totalizer **16** has ten denominations, the totalizer **17** six denominations and the totalizer **18** twelve denominations.

In Fig. 1 the six denominational totalizer **17**, is, for example, in the working position in which the units denomination of the totalizer **17** is opposite to the actuator segment **19** (Fig. 14) lying farthest to the right.

Setting up of a value into the adjusting and indicating wheels

The value to be registered in one of the totalizers is first set in an adjusting wheel carriage **20** (Figs. 7, 14 and 15). This is performed by depression of the corresponding keys **1**, whereby the following mechanisms are operated.

First, it is necessary to switch in the motor **9** by means of the handle **13**, whereon the motor **9** commences to rotate. The main drive shaft **12** and the toothed wheel **21** mounted on the shaft are hereby rotated in the arrow direction **22** (Fig. 9) by way of the worm **10** and the worm wheel **11**. The toothed wheel **21** engaging with the intermediary toothed wheel **22***a* which engages with the intermediary toothed wheel **23**. The latter drives the toothed wheel **24** in the arrow direction **25**. The wheel **24** is rigidly connected with a stub shaft **26** (Fig. 12) which is rotatably mounted in the plate **27**. The stub shaft **26** is secured against axial displacement by means of a collar **28** (Figs. 9 and 12) and a screw **29** (Fig. 16). In order to transmit the driving movement to the stub shaft **30**, a plug connection **31** (Fig. 12) is provided. The stub shaft **30** is rotatably mounted in a U-shaped part **32** (Figs. 3 and 2) which latter is fixed to the machine frame **33** in any suitable manner. On the stub shaft **30**, a toothed wheel **34** is rigidly mounted which meshes with a toothed wheel **35**. The latter is in engagement with the toothed wheel **36** which rotates in the arrow direction **37**. The wheel **36** is rotatably mounted on a rotatably mounted shaft **38**. A sleeve **39** is slidably but non-rotat-

ably arranged on the shaft 38 by means of a pin and slot connection 40, 41. Between the sleeve 39 and the wheel 36 a washer 42 of vulcanized fibre is arranged. The washer 42 constitutes a friction member which is pressed against the wheel 36 by means of a compression spring 43, arranged between the sleeve 39 and a collar 44 fixed on the shaft 38. On the shaft 38, a master wheel 45 is rigidly mounted. With the wheel 45 (Fig. 2), two teeth 46 of a lever 47 are engaged holding thereby the parts 45, 38, 44, 39 against rotation, whereas the wheel 36 rotates as long as the switching in lever 13 is set to "On" (Fig. 8).

On the depression of one of the keys 1 (Fig. 5) the corresponding key stem 48 is moved downwards against the action of its spring 49. Hereby the upper edge 50 of the slot 51 located in the key stem 48 acts on the pin 52 of the corresponding slide 53, whereby the latter is moved rearwards in the arrow direction 54 so that the nose 55 (Figs. 5 and 6) arranged on the slide 53 moves into the path of movement of the tooth 56 (Fig. 2) of the adjusting and indicating wheel 57 standing in the working position.

Simultaneously with the depression of one of the keys 1 (Figs. 5 and 6), the associated key stem 48 acts with its lower edge 58 of the reduced part 59 on the part 60 or 61 (Fig. 6) of the lever 47 (Figs. 2 and 5) whereby the lever 47 is swung in the clockwise direction round the screw 62 (Fig. 2). Hereby, the teeth 46 of the lever 47 move out of engagement with the teeth of the toothed wheel 45 so that the latter in consequence of the frictional force exerted by the spring 43 (Fig. 3) can participate in the rotation of the toothed wheel 36 in the arrow direction 37, indicated in Fig. 2 owing to the action of the parts 42, 39, 40, 41 and 43. Since the extreme left hand adjusting and indicating wheel 57 of the adjusting wheel carriage 20 (Fig. 16) in the extreme right hand position of the same is located with its teeth 63 in engagement with the teeth of the toothed wheel 45 (Fig. 3) the adjusting and indicating wheel 57 is swung round the shaft 64 in the anti-clockwise direction until its tooth 56 strikes the nose 55 of the slide 53 corresponding to the depressed key 1, whereby the adjusting and indicating wheel 57 as well as the toothed wheel 45 in engagement with the same are prevented from further rotation in consequence of the friction drive 42, 39 while the toothed wheel 36 can still be rotated continually.

As soon as the adjusting and indicating wheel 57 has come to a standstill, the value corresponding to the depressed key 1 is visible in the inspection aperture 3 (Fig. 1) of the indicating mechanism.

In the depression of one of the keys 1, the corresponding key stem 48, as already described, acts on the lever 47 (Figs. 2 and 5) and the part 65 of the part 60 rivetted to the lever 47 acts on the edge 66 of the lever 67 (Fig. 2) rigidly mounted on the shaft 68, and swings the same in the clockwise direction. Hereby, the right- angled bent-off end 69 (Fig. 4) projecting from the left hand side wall 70 (Fig. 16) of the shaft 68 acts upwards on the part 71 mounted on the escapement rocker 72 (Fig. 4), whereby the escapement 73, 74 (Figs. 4 and 18) is actuated so that on the release of the key 1 concerned, the parts 64, 57, 75 and 76 (Fig. 19) which represent the adjusting wheel carriage are moved one step to the left, since the lever 77 (Fig. 7) with its part 78 acts under the pull of the spring 79 on the shaft 64. Hereby, the extreme left-hand adjusting and indicating wheel 57 moves out of engagement with the wheel 45 and into engagement with the teeth 80 of the right-hand actuator sector 19, whilst the second adjusting and indicating wheel 57 moves into engagement with the driving wheel 45.

Now the next key 1 can be depressed or the next number brought into the succeeding adjusting and indicating wheel 57, whereby the above described operations again take place for which reason they will not be further described.

Now, if in the adjustment of a numerical value a zero in the numerical value is to be set, it is only necessary to depress the zero key 2, whereby the following mechanisms are actuated.

On depression of the key 2, the key slide 81 is moved downwards against the action of the spring 82, whereby the same acts with its lower edge on the edge 83 (Fig. 2) of the lever 67 and rocks the latter as well as the shaft 68 in the clockwise direction, whereby the escapement on release of the key 2 is operated by way of the parts 69, 71. In consequence of this, a movement of the adjusting and indicating wheels 57 to the left takes place through one step. Since in the depression of the zero key 2 the lever 47 is not operated, the teeth 46 of the same do not release the toothed wheel 45 and obviously the corresponding adjusting and indicating wheel 57 cannot be rotated by way of the same. In the inspection aperture 3 of the indicating mechanism, there is thus a zero visible in this denomination.

Operation of the drive for the adding and printing mechanism

If it is desired to add and print the set up value the key 84 (Figs. 7 and 10) is depressed, whereby the key lever 4 is rocked round the screw 85 in the clockwise direction against the action of the spring 86 which engages with it. Hereby, the angle-lever 87 (Figs. 10 and 13) is rocked in the anti-clockwise direction round the screw 88 through the intermediary of the connecting rod 89. Consequently the pawl 90, which is pivotally arranged on the coupling lever 87 by means of a screw 91, comes with its nose 92 into the path of movement of the nose 93 of the coupling pawl 94 (Figs. 10, 11, 12 and 22). Furthermore, on depression of the key 84 the lug 95 (Figs. 7 and 10) bent off from the key lever 4 acts on the key lever 5 and rocks the same likewise in the clockwise direction round the screw 85. In this movement the projection 96 of the rearwardly directed part of the key lever 5 acts upwards against the bridge 97 (Fig. 8) of the U-shaped part of the coupling lever 98, whereby the latter is rocked round the screw 99 in the clockwise direction against the action of the spring 100. Hereby the nose 101 of the coupling lever 98 releases the nose 93 (Figs. 10 and 11) of the coupling pawl 94 located in the coupling casing 102. The coupling pawl 94 under the action of the spring 103 engaging with its nose 104 (Fig. 11) can now swing round the pin 105 in the anti-clockwise direction, whereby the nose 106 of the coupling pawl 94 comes into the path of movement of the cam 107 rigidly mounted on the main drive shaft 12. Since, as already described, the shaft 12 and the cam 107 are already in rotation, owing to the switching in of the motor 9, the nose of the cam 107 acts on the nose 106 of the coupling pawl 94 which has been brought into engagement with it. Since this pawl, in consequence of the action of the spring 103 is held in engagement with the

cam 107, the latter takes along with it the pawl 94 and consequently also the coupling casing 102 in the arrow direction 22.

In the rotation of the coupling 102 in the arrow direction 22 the rod 108 (Fig. 22) is moved in the arrow direction 109, owing to its connection to the cover 110 of the coupling housing 102 by means of the headed screw 111. By the movement of the rod 108 in the arrow direction 109 the stub shaft 112, fixed to the rod 108 is equally moved in the direction of the arrow 109. As a result, the lever 113 (Figs. 22 and 15) is moved in the arrow direction 109, rotating thereby the arm 114 in the direction of the arrow 115. The arm 114 is rigidly mounted on a shaft 116, rotatably mounted in the machine frame 33. On the other end of the shaft 116, a second two-armed arm 117 is rigidly mounted to which a lever 118 is pivoted which latter carries a stub shaft 119 axially arranged to the stub shaft 112. In the rotation of the shaft 116 participates also the toothed wheel 120 (Figs. 15, 16 and 14).

Simultaneously with said movement of the parts 102, 108, 112, the parts 264, 263 are moved in the same sense, whereby the shaft 240 (Fig. 22) is rotated likewise in the arrow direction 115. However no further mechanisms are operated thereby.

Since the toothed wheel 120 is in engagement with the toothed wheel 121 mounted on the shaft 122, the toothed wheel 121 is rotated in the arrow direction 123. The toothed wheel 124 mounted on the shaft 125 and standing in engagement with the toothed wheel 120 is hereby rotated in the arrow direction 126.

The cams 127 and 128 (Figs. 16, 19 and 23) rigidly mounted on the shaft 125 also participate in the rotation of the shaft 125 in the arrow direction 126. The cam 127 may be called the total cam because it controls the totalizer in total taking, whereas the cam 128 may be called the adding cam because it controls the totalizer in addition. Normally the cam 128 is in contact with the nose 129 of the lever 130 and as the nose 129 of the lever 130 in the rotation of the cam 128 in the arrow direction 126 slides on the lower part of the cam 128 (Fig. 19) the latter has no action during the first half of its revolution on the lever 130.

Consequently, the nose 131 may not act on the lug 132 of the totalizer frame 133, swingable round the shaft 134 (Fig. 19).

Referring now again to the stub shafts 119 and 112 in Fig. 15, it may be noted that each of them is pivotally connected to toothed sectors 136 and 137. The stub shafts 119 and 112 are guided in slots (not shown) in the side walls of the machine frame, which slots are concentrically arranged with the toothed sectors 136 and 137. The toothed sectors 136 and 137 are connected by a bar 138, cooperating with noses 139 (Fig. 14) on the actuators 19.

When the toothed sectors 136 (Fig. 15) and 137 are acted upon in the arrow direction 140 by way of the levers 113 and 118 in the above mentioned rotation of the lever 114 and 117 in the arrow direction 115, the bar 138 also travels in the arrow direction 54, whereby the noses 139 (Figs. 14 and 19) of the actuators 19 are released for movement. In this operation the toothed segments 141 and 142 (Fig. 15) which are in engagement with the toothed sectors 136 and 137 are swung round the shaft 64 in the clockwise direction in which swinging movement the beam 76 projecting into the recesses 143 and 144 of the toothed segments 141 and 142 also participates. In the swinging movement of the beam 76 in the clockwise direction round the shaft 64, this beam 76 acts successively on the edges 145 of the adjusting and indicating wheels 57 and swings the same in succession according as the adjusting and indicating wheels 57 were swung more or less in the anti-clockwise direction round the shaft 64 in the setting operation correspondingly to the set value.

As soon as the adjusting and indicating wheels 57 have swung in the clockwise direction in consequence of the action of the beam 76, the actuator segments 19 standing in engagement with the adjusting and indicating wheels 57, so far as in the denomination concerned a value was set, are also acted upon in the arrow direction 140 (Figs. 14, 19 and 20).

Operation of the printing mechanism

As soon as the beam 76 (Fig. 15) has returned the setting and indicating wheels 57 to the zero position, the actuator sectors 19 have been moved so far in the arrow direction 140 that the type members 146 mounted on the actuator sectors 19, corresponding to the value brought into the setting and indicating wheels 57 have moved into the printing position.

During the first half revolution of the shaft 116, the roller 147 (Fig. 14) of the lever 148 slides from the elevated part of the cam 149 on to the lower part of the cam 149, whereby the lever 148 and the shaft 150 are rocked in the anti-clockwise direction. Hereby the lever 148 is likewise rocked in the anti-clockwise direction under the action of the spring 151, whereby the connecting rod 152 is moved downwards. Consequently the bail 153, 154, 155 is rocked round the shaft 156 in the anti-clockwise direction into the position shown in Fig. 14 in dotted lines, so that the type hammers 157 are released.

After one-half of a revolution of the main drive shaft 12 (Figs. 9, 10) in which revolution the coupling casing 102 also participates, the nose 92 of the pawl 90, which on the depression of the key 84 moved into the path of movement of the nose 93 of the coupling pawl 94 in consequence of the further holding of the key 84 depressed, cooperates with the nose 93 of the coupling pawl 94, whereby the latter is swung round the pin 105 in the clockwise direction against the action of the spring 103, whereby the nose 106 of the coupling pawl 94 moves out of engagement with the cam 107. While the main drive shaft 12 still rotates the coupling casing 102 and the mechanisms in connection with it have come to rest.

As soon as the nose 93 of the coupling pawl 94 acts upon the nose 92 of the pawl 90, the latter is rocked in the clockwise direction round the screw 91, whereby the connecting rod 158 (Figs. 10 and 14) is moved downwards against the action of the spring 159. Hereby the bail 160, 161, 162 is rocked in the clockwise direction round the shaft 163, whereby the projection 164 of the bridge 162 of the locking bail 160, 161, 162, releases the projections 165 of the hammers 157, so that the same are swung in the anti-clockwise direction round the shaft 156 under the action of the springs 166. Consequently the hammers 157 strike against the printing types 146, whereby the value, which has been set, is typed upon the platen 167. After the printing has been effected, the hammers 157 fall back

into the position shown in Fig. 14 in dotted lines, in which position the hammers 157 are held by the springs 166.

During the printing of the value upon the platen 167 (Fig. 14) the cam 168 which is arranged on the shaft 122 acts with its elevated part upon the nose 169 of the lever 170, whereby the bail 170, 171, 172 is rocked in the anti-clockwise direction round the shaft 173 against the action of the spring 174, so that the part 171 of the bail 170, 171, 172 comes into engagement with the teeth 80 of the actuator sectors 19.

Consequently the actuator sectors 19 are locked in their printing position. After the printing is effected the nose 169 of the lever 170 of the bail 170, 171, 172 slides from the elevated part of the cam 168 on the lower part of the cam 168, whereby the bail 170, 171, 172 is rocked round the shaft 173 under the action of the spring 174 in the clockwise direction, so that the part 171 of the bail 170, 171, 172 comes out of engagement with the teeth 80 of the actuator sectors 19, whereby the same are unlocked.

After the printing is effected, the key 84 (Fig. 10) is released, whereby the key lever 4 under the action of the spring 86 rocks round the arrow 85 in the anti-clockwise direction and is brought back into its position illustrated in Fig. 10. The angle lever 87 is hereby swung in the clockwise direction round the screw 88 by way of the connecting rod 89 until the part 175 (Fig. 13) of the pawl 87 strikes the pin 176, whereby the rest position of the parts 87, 89, 4 is determined.

In this operation, the nose 92 (Fig. 10) of the pawl 90 has released the nose 93 of the coupling pawl 94 (Fig. 11) so that the same can swing round the pin 105 under the action of its spring 103, whereby the nose 106 of the coupling pawl 94 comes again into the path of movement of the cam 107, so that the coupling casing 102 again participates in the further rotation of the cam 107. In the swinging of the lever 4 in the anti-clockwise direction (Fig. 10), the lever 5 under the action of the spring 177 can likewise swing round the screw 85 in the anti-clockwise direction and return into its rest position illustrated in Fig. 10, since the lug 95 arranged on the lever 4 releases the lever 5. The projection 96 of the rearwardly directed part of the lever 5 hereby releases the bridge 97 of the pawl 98 so that the latter under the action of its spring 100 can swing back into its rest position, illustrated in Fig. 10, which is determined by the striking of the downwardly directed limb of the U-shaped part 178 of the pawl 98 against the plate 27. In the swinging of the pawl 98 in the anti-clockwise direction the nose 101 of the same has been moved into the path of movement of the nose 93 of the coupling pawl 94.

As soon as the projection 92 of the pawl 90 releases the projection 93 of the pawl 94 of the coupling housing 102, the pawl 90 is rocked in the anti-clockwise direction round the screw 91 under the action of the spring 159 (Fig. 14), which is arranged on the connecting bar 158 so that the bail 160, 161, 162 is rocked in the anti-clockwise direction round the shaft 163 in the position, shown in Fig. 14. In this position the projection 164 of the bridge 162 of the bail 160, 161, 162, comes in the moving path of the projection 165 of the hammers 157.

After a half revolution of the shaft 116, the roller 147 (Fig. 14) of the lever 148 slides from the lower part of the cam 149 on the elevated part of the cam 149, whereby the lever 148, the shaft 150 and the lever 179 are rocked in the clockwise direction against the action of the spring 151. Hereby the connecting rod 152 is moved upwards, whereby the bail 153, 154, 155 is rocked in the clockwise direction round the shaft 156. Consequently the bar 155 of the bail 153, 154, 155 acts upon the hammers 157, so that the hammers 157 are rocked in the clockwise direction round the shaft 156 against the action of the springs 166. Hereby the projection 165 of the hammers 157 acts upon the projection 164 of the bridge 162 of the bail 160, 161, 162 and rocks the same in the clockwise direction round the shaft 163 against the action of the spring 159, which is connected with the connecting rod 158. The rocking movement of the pawl 90 remains hereby without influence on the parts. As soon as the projection 165 of the hammers 157 comes to lie underneath the projection 164 of the bridge 162 of the bail 160, 161, 162, the projection 164 of the bridge 162 of the bail 160, 161, 162 snaps under the action of the spring 159 over the projections 165 of the hammers 157 so that the same are locked in their rest positions.

Operation of the adding mechanism

During the second half of the revolution of the coupling casing 102 in the arrow direction 22 (Fig. 10) the toothed sectors 136 and 137 (Fig. 15) are moved by way of the levers 118 and 113 in the opposite direction of the arrow direction 140 whereby the toothed segments 141 and 142 standing in engagement with them are acted upon round the shaft 64 in the anti-clockwise direction, whereby the beam 76 is likewise swung in the anti-clockwise direction into the normal position represented in Fig. 15.

Besides the actuator sectors 19 are naturally also brought back into the rest position by the beam 138 fixed to the toothed sectors 136 and 137 in consequence of its action on the noses 139 (Fig. 14) of the actuator sectors 19.

Directly at the beginning of the second half-revolution of the main drive shaft 12 the cam 128 (Figs. 19 and 23) acts with its raised part on the nose 129 of the two-armed lever 130, whereby the latter is swung round the shaft 180 in the anti-clockwise direction against the action of the spring 181. In the swinging movement of the lever 130 in the anti-clockwise direction the nose 181 of the lever 130 acts on the lug 132 of the totalizer frame 133 whereby the same is swung in the clockwise direction round the shaft 134 (Fig. 19) mounted in the two side walls of the totalizer with the result that the toothed wheels 134*a* of the totalizer located in the working position move into engagement with the teeth of the racks 135 of the arms 182 of the toothed sectors 19. Now, as soon as the toothed sectors 19 are moved in the opposite direction to the arrow 140, the toothed wheels 134*a* of the totalizer located in the working position are rotated in the arrow direction indicated in Fig. 19, since, as hereinbefore described, the toothed wheel set 134*a* has been brought into engagement with the racks 135. Consequently, the numeral wheels 183, which are in fixed connection with the toothed wheels 184 are rotated by way of the toothed wheels 185, 186 in the clockwise direction corresponding to the value brought into the setting and indicating wheels 57. The value registered on the numeral wheels 183 is visible in the inspection aperture of the totalizer.

Shortly before the completion of a full revolu-

tion of the coupling casing 102 the nose 129 (Fig. 23) of the two-armed lever 130 slides off from the raised part of the cam 128, whereby the lever 130 is swung round the shaft 180 in the clockwise direction under the action of the spring 181. With this, the nose 131 of the lever 130 releases the lug 132 of the frame 133 of the totalizer, located in the working position, whereby the same is swung round the shaft 134 (Fig. 19) in the anti-clockwise direction under the action of its spring 187 until the frame 133, strikes against the pin 188 on the right hand side wall of the totalizer casing, with the result that the toothed wheel set 134*a* moves out of engagement with the racks 135.

If now, for example, in the numeral wheels 183 a value has been registered and if through a succeeding addition a value has been registered which in certain denominations rotates the numeral wheels from "9" to "0" a tens transfer takes place in the manner, described in the following chapter "Tens carrying mechanism."

Tens carrying mechanism

Let it be assumed that in the third denomination from the right a value e. g. "6" has been registered by a preceding calculating operation. If now, a "5" is to be added, then in the rotation of the numeral wheel 183 (Fig. 20) of the third calculating place from "9" to "0", the tooth 189 (Fig. 24) arranged on the toothed wheel 185 acts on the nose 190 of the lever 191 and swings the same in the clockwise direction round the shaft 192. As soon as the nose 190 of the lever 191 acts upon the arm 193 of the lever 194 the latter is swung in the anti-clockwise direction round the shaft 195 against the action of the spring 196.

In the swinging movement of the three-armed lever 194 in the anti-clockwise direction, the nose 197 of the arm 198 of the three armed lever 194 slides along on the face 199 of the nose 200 of the pawl 201. As soon as the lug 197 of the arm 198 of the lever 194 slides off from the nose 199 of the pawl 201, the latter under the action of the spring 202 snaps over the lug 197 of the arm 198 so that the lever 194 is held in this position.

In the swinging movement of the three-armed lever 194 in the anti-clockwise direction, the lever 202*a* is swung in the clockwise direction round the shaft 203 in consequence of the connection 204, whereby the nose 205 of the lever 202*a* is moved on by one tooth division in front of the rack 135 of the next higher place.

In the swinging movement of the three armed lever 194 in the anti-clockwise direction, its arm 206 acts on the slide 207, which latter releases thereby the lug 208 of the rack 135.

If therefore the toothed sectors 19 are moved in the opposite direction of the arrow 140 towards their rest position in the manner hereinbefore described, the rack 135 of the fourth denomination from the right is released by the slide 207 and moved through one tooth division in relation to the sector 19 under the action, of the spring 209. The result of this is that the numeral wheel 183 corresponding to the fourth denomination is rotated further through one unit in the clockwise direction with which the tens transfer from the third to the fourth denomination has taken place.

Immediately after the disengagement of the totalizer wheels 134*a* with the racks 135, the nose 210 of the cam 211 acts on the nose 212 of the yoke 213, 214, 215 and swings the same round the shaft 216 against the action of the spring 217. Hereby the bridge 215 of the yoke 213, 214, 215 acts on the noses 218 of the levers 201 and swings the same round the shaft 219 in the anti-clockwise direction against the action of the spring 202, whereby the nose 199 of the lever 201 of the fourth denomination releases the nose 197 of the arm 198 of the lever 194. In consequence of this, the lever 194 is swung round the shaft 195 in the clockwise direction under the action of the spring 196, whereby it strikes against the pin 220 and takes up its normal position, shown in Fig. 20, in relation to the lever 201. In the swinging movement of the lever 194 in the clockwise direction, the lever 202*a* is swung in the anti-clockwise direction in consequence of the connection 204, whereby it acts with its nose 205 on the rack 135 of the fourth denomination and moves the same back against the action of the spring 209 into the normal position, illustrated in Fig. 20, in which the slide 207 snaps behind the lug 208 of the rack 135 and locks the same. Of course, the spring 196 must be stronger than the spring 209.

Retraction of the adjusting and indicating wheels to their right hand position

During the movement of the shaft 64 and of the adjusting and indicating wheels 57 to the left (seen in Fig. 15), the shaft 64 acts upon the forwardly directed arm 221 (Fig. 16) of the three-armed lever 222, whereby the three-armed lever 222 is rocked in the clockwise direction round the screw 223 against the action of the spring 224. Hereby the arm 225 of the three-armed lever 222 comes to lie in the moving path of the lever 226 (Fig. 18). As long as the key lever 4 is not depressed, the lever 226 is held in its normal position, shown in Fig. 18 by the spring 227. In this position the lever 226 is not capable of coacting with the arm 225 of the three-armed lever 222, nor with the nose 228 (Fig. 18) of the lever 117, because the normal position of the lever 226 as viewed in Fig. 16 is at the right hand of the lever 117.

On depression of the key lever 4, the same is rocked round the screw 85 (Fig. 10) in the clockwise direction. Hereby the lever 4 acts upon the projection 229 of the angle lever 230, which is rocked in the anti-clockwise direction round the shaft 231. Consequently, the connecting rod 232 (Fig. 16) is moved against the direction of the arrow 54, whereby the angle lever 233 is rocked round the screw 234 in the clockwise direction, so that the shaft 235 is moved to the left against the action of the spring 236. Hereby the lever 226, which is fixed on the shaft 235 comes in the moving path of the levers 225 and 117.

As soon as the printing operation has taken place, the projection 228 (Fig. 18) of the lever 117 acts upon the projection 237 of the lever 226, whereby the same is rocked against the action of the spring 227 in the anti-clockwise direction. Hereby the lever 226 acts with its surface 238 upon the arm 225 (Fig. 16) of the three armed lever 222, whereby the same is rocked in the anti-clockwise direction round the screw 223. Consequently, the arm 221 of the three armed lever 222 acts upon the shaft 64 so that the latter and the adjusting and indicating wheels 57 are moved to the right to their normal position. Since the bringing back of the adjusting and indicating wheels 57 takes place in the position of the driving cranks 117, 118 in which position the toothed actuator sectors 19 have already come to rest, it is possible to move the adjusting and indicating wheels 57 to the right through the tooth spaces of the toothed actuator sectors 19.

When the key lever 4 is released, whereby the same is rocked round the screw 85 (Fig. 10) in the anti-clockwise direction, the lever 230 is rocked round the shaft 231 in the clockwise direction, the connecting bar 232 (Fig. 16) moved in the direction of the arrow 54, the angle lever 233 is rocked round the screw 234 in the anti-clockwise direction and the shaft 235 is moved to the right under the action of the spring 236. Hereby the lever 226 comes again out of the path of movement of the crank lever 117 and of the arm 225 of the three-armed lever 222.

Coupling and driving mechanism for total taking

In a bracket 239 (Fig. 22) fixed in any suitable manner to the machine frame 33, a stub shaft 240 is rotatably mounted, which shaft is axially arranged to the shafts 12 and 116. On the stub shaft 240, a ratchet wheel 241 is rigidly mounted. The key lever 6 is mounted on the bolt 243 of a U-shaped part 244 (Fig. 8), which is mounted by means of screws 245 on the right hand side wall of the machine frame 33 and is normally maintained in its position by the spring 246 (Fig. 22) engaging on the one hand the hook 247 of the lever 6 and on the other hand the stationary bolt 248. The abutment or stop 249 contacting with the hook 247 of the lever 6 limits its pivoting action in one direction. The abutment or stop 249 is fixed to the machine frame by means of a bracket (not shown).

When the key 8, which is marked with "T" is depressed, the lever 6 being rocked on its pivot 243 clockwise, whereby the nose 251 of the pawl 252 is released by means of the rearwardly directed arm of the key lever 6. Since the pawl 252 is movable on the cam disc 253, which is rotatably mounted on the shaft 240, the pawl 252 is thus caused to move in the direction indicated by the arrow 254 by the compression spring 255 (Fig. 21). Consequently, the nose 256 of the pawl 252 engages with the continuously rotating ratchet wheel 241. The cam 253 is thus coupled with the ratchet wheel 241.

In order to maintain the cam disc 253 in its normal position shown in Figure 21, the cam 253 is secured to a disc 257 on which is rotatably mounted a roller 258 on the opposite side of the cam 253. The said roller 258 cooperates with the lever 259 which is also mounted on the bolt 243 and is always kept in contact with the roller 258 by a spring 260 secured to the lever 259 and also at 261 on the machine frame. Since the end of the lever 259 does not bear against the stop 249, the cam disc 253 will always be urged in the direction of the arrow 262 by the spring 260 acting through the lever 259, the roller 258 and the disc 257, while the rotation of the cam disc 253 is prevented by the lug 251 of the pawl 252 coming in contact against the end of the lever 6 and consequently the cam disc 253 is maintained in its normal position.

From the foregoing it results that if the key 8 is depressed and immediately released the disc 257 will perform one revolution only. The movement to the stub shaft 240 being transmitted through the levers 263, 264 from the stub shaft 112, which in its turn receives its driving movement from the coupling 102.

Prior to the completion of a revolution of the stub shaft 240, the roller 258 of the disc 257 comes in contact with the curved end of the lever 259 and rocks the same on its pivot 243 counter-clockwise against the action of the spring 260 engaging therewith until the roller 258 goes beyond the dead centre. From this moment the lever 259 exerts a driving action on the roller 258 and on the cam disc 253, whereby a rotary motion independent of the stub shaft 240 is imparted to the cam disc 253 and simultaneously effects a lead of the cam disc 253 relative to the stub shaft 240 and the ratchet wheel 241 respectively, thereby facilitating the uncoupling of the pawl 252 from the ratchet wheel 241.

Total taking mechanism

To the disc 257 described under the chapter "Coupling and driving mechanism for total-taking", is jointed a rod 265 (Figs. 21 and 8) by means of the pin 266 and this rod is in articulated connection with a lever 267 (Fig. 20) rigidly mounted on a shaft 268 which is rotatably mounted in the two side walls of the machine frame 33. On the shaft 268, further, a toothed segment 269 is rigidly mounted which is adapted to co-act with parts to be later described in detail.

On the toothed segment 269 is formed a nose 270 which is adapted to co-act with a nose 271 bent off at right angles on one arm of a bail 272, 273. The bridge 273 of the bail 272, 273 is adapted to co-act with the three-armed levers 194. When the segment 269 is rocked clockwise, the nose 270 rocks the bail 272, 273 anti-clockwise and maintains the same in its rocked position by means of the concentric part 274 of the segment 269, in which position the tens transfer levers 194 are locked for total taking.

On the lever 6 is formed a lug 275 (Figs. 16 and 20) which engages over the key lever 4 and is adapted to co-act with this key lever in a manner to be hereinafter described.

On the lever 6 (Figs. 16 and 26) is formed a nose 277 which is adapted to co-act with the forwardly directed arm of a two-armed lever 278. The two-armed lever 278 is pivotably mounted on an angle member 279 (Fig. 16) attached by means of screws 280 to the right hand side wall of the machine frame 33. On the rearwardly directed limb of the two-armed lever 278 is arranged a pin 281 (Fig. 23) which projects into a ring groove 282 of a ring groove sleeve 283. The ring-groove sleeve 283 is rigidly mounted on the shaft 125. By means of a spring 284 which on the one hand lies against the right-hand side wall of the machine frame and on the other hand lies against the ring groove sleeve 283. The normal position of the shaft 125 is determined by the striking of a collar 285 (Fig. 16) against the left hand side wall of the machine frame 33. Further, a driving wheel 124 (Figs. 16, 19 and 23) is fixed to the shaft 125 and is in engagement with a toothed wheel 120 arranged on the shaft 116, the wheel 120 being twice as broad as the toothed wheel 124 so that the toothed wheel 124 remains in engagement with the toothed wheel 120 when the shaft is displaced in the arrow direction 286 (Fig. 16) in a manner to be hereinafter described.

Besides the cam 128 for addition, a second cam 127 for total taking is mounted on the shaft 125 which is constructed as shown in Fig. 23 and is adapted to cooperate with the totalizer controlling lever 130.

In the shaft 192 (Figs. 20 and 24) is located a half round groove in which a rotatable key 287 is laid, and this key is recessed in the zone of the wheels 185 at 288 corresponding to the arc of the circumference of the shaft 192 so that the arc-shaped face 288 and the remaining circum-

ference of the shaft 192 form a closed cylindrical surface. At the left-hand end is provided a second short face 289 displaced in relation to the face 288. The face 289 on the displacement by rotation of the rotatable key 287 in the opposite direction to the arrow 290 being likewise adapted to form a cylindrical surface with the remaining surface of the shaft 192. In the normal or home position (Figs. 24 and 27) of the shaft 192, the edge of the face 289 of the rotatable key 287 lies on the locking edge 291 of the hole 292 in the left hand side wall of the totalizer frame 133.

The shaft 192 is provided with collars 293. On each pair of such collars runs a wheel 185 which is provided in its bore 294 with a cam 295. This lies in the ring groove 296 formed by each pair of collars.

If the rotatable key 287 is located in the normal or home position illustrated in Figs. 24 and 27, the wheels 185 can freely rotate in each direction since the cams 295 lying in their bores 294 can freely rotate past the rotatable key 287.

On the right-hand side wall of the totalizer frame 133 the shaft 192 is mounted with its reduced journal 297 in the hole 298. This hole is provided with a recess 299 (Fig. 25). In the same is provided a locking cam 300 (Figs. 24, 25, 27 to 29) which is adapted to co-act with the rotatable key 287 on rotation of the shaft 192 in the arrow direction 290. The right-hand end 297 of the shaft 192 projects through an elongated hole 301 of the right-hand side wall 302 of the totalizer casing.

On the journal 303 of the shaft 192 is fixed a toothed wheel 304 which is capable of being driven by the toothed segment 269 (Fig. 20) in the arrow direction 290 (Figs. 24, and 27 to 29) when the segment 269 is swung in the arrow direction 305 (Fig. 20).

The shaft 125 (Fig. 16) is provided with ring grooves 306 and 314 with which a pawl 307 (Fig. 16 and 19) is capable of engaging, the pawl being swingably mounted on a pin 308. The pin 308 is fixed to a bracket (not shown) arranged on the machine frame in any suitable manner. By means of a torsion spring (not illustrated) the pawl 307 is acted upon so that it is laid upwards against the shaft 125. The other end of the pawl 307 is adapted to co-act with a cam 309 arranged on the shaft 116.

Total taking

If, for example, a total is to be taken from the six denomination totalizer 17 (Fig. 1), first of all, the totalizer is brought into the working position and the total key 8 (Fig. 22) is depressed whereon the following operation occurs:

By depressing the key 8 of the key lever 6 the coupling 241, 252 is closed, as described under the chapter "coupling and driving mechanism for total taking."

On depression of the total key 8 the incline 277 (Figs. 16 and 26) formed on the key lever 6 acts on the lever 278, whereby the latter is swung round the screw 310 in the clockwise direction. As a result, the ring groove sleeve 283 (Figs. 23 and 16) arranged on the shaft 125, the toothed wheel 124, the two cams 127, 128 and the shaft 125 itself are moved in the arrow direction 286 against the action of the spring 284, whereby the cam disc 128 moves out of the working position in relation to the nose 129 of the lever 130 and the cam 127 moves into the working position with the nose 129 of the lever 130. At this moment the horizontal limb of the pawl 307 springs into the ring groove 306 of the shaft 125 and holds the parts 283, 124, 127, 128 arranged on the shaft, in the displaced position.

In the swinging of the lever 278 in the clockwise direction round the screw 310, the part 311 formed as shown in Fig. 26 is acted upon to the left whereby the face 312 of the part 311 is laid over the key lever 4, depressed through the lug 275 of the depressed total key lever 6. Consequently, on the release of the total key 8 the lever 4 is prevented from returning to its normal position.

As has been explained under the chapter "Operation of the drive for the adding and printing mechanism" on depression of the lever 4, the coupling 102 is closed and the shaft 12 commences to rotate in the arrow direction 22.

During the rotation of the coupling 102 and the shaft 12 in the arrow direction 22, the shaft 116 (Fig. 15) is driven in the direction of the arrow 115 by means of the parts 108 (Fig. 22) 112, 113, 114 in which rotation the toothed wheel 120, arranged on the shaft 116 also participates. Since the toothed wheel 120 (Fig. 19) is in engagement with the toothed wheel 124, the cams 127 and 128 are rotated in the direction of the arrow 126. Hereby the raised part of the cam 127 (Fig. 23) acts on the nose 129 of the lever 130 and swings the same in the anti-clockwise direction round the shaft 180 against the action of the spring 181. The nose 131 of the lever 130 hereby acts on the lug 132 of the totalizer frame 133, whereby the same is swung round the shaft 134 (Fig. 20) in the clockwise direction against the action of the spring 187 so that the toothed wheels 134*a* move into engagement with the teeth of the racks 135.

As described above under the chapter "Coupling and driving mechanism for total taking," the shaft 240 is coupled with the discs 253, 257 on the depression of the total taking key 8. On the beforementioned movement of the parts 108, 112, 113, 114, the shaft 240 and the parts 253, 257 coupled therewith are driven in the arrow direction 115 by the parts 112, 264, 263 (Fig. 22).

By this rotation of the disc 257 (Fig. 22) the connecting rod 265, jointed to it by means of the pin 266, is actuated and swings the lever 267 (Fig. 20) which is jointed to it and which is rigidly mounted on the shaft 268, in the clockwise direction. In the swinging movement of the lever 267 participitates also the toothed segment 269 rigidly mounted on the shaft 268 and this toothed segment in one revolution of the disc 257 is swung once to and fro. At this point it may be mentioned that the disc 257 only makes one revolution. Directly at the commencement of the actuation of the segment 269 the projection 270 arranged on the same acts on the nose 271 of the bail 272, 273 and swings the same in the anti-clockwise direction whereby the bridge 273 of the bail 272, 273 is laid upwards against the lever 194. Thereby the levers 194 are locked so that the tens transfer levers 190 are held in the path of the tens transfer cams 189 (Fig. 24) of the toothed wheels 185. The tens transfer levers 190 are held in this position by the reciprocating cam running concentrically with the pivot of the segment 269.

The segment 269 in its swinging movement in the arrow direction 305 drives the wheel 304 (Fig. 24) lying opposite to it in the arrow direction 290, whereby the shaft 192 is likewise rotated in the arrow direction 290 from the position ac-

cording to Fig. 27 to the position according to Fig. 29, which movement is approximately through 340 degrees of the released revolution. In this rotation the control cam 291 of the hole 292 of the left hand side wall of the totalizer frame acts on the surface 289 of the rotatable key 287, whereby the same is rotated in the opposite direction to the arrow 290. Consequently, the edge 313 of the part 288 of the rotatable key 287 moves out from the periphery of the shaft 192 and acts as driver for the cams 295 of the wheels 185, whereby these and the numeral wheels 183 in connection with them are carried back to zero. The zeroizing is finished as soon as the edge 313 of the rotatable key 287 strikes on the cam 300 (Fig. 29) located in the recess 299 of the right hand side wall of the totalizer frame.

Simultaneously in this zero position of the wheels 185, the tens transfer cams 189 (Figs. 24 and 29) of the wheels 185 strike against the noses 190 of the tens transfer levers 191, which levers 191 are brought to their working position with regard to said transfer cams 189 and locked in the same in the manner above described. Thereby an over-shooting of the reset wheels 185 and the number wheels 183 is prevented.

Since the shaft 192 does not make a complete revolution but is rotated only through 340 degrees, the shaft 192 does not come to its home position according to Fig. 27. The lock 289, 291 may only be operated when the resetting parts are in the home position according to Fig. 27, while the lock 289, 191 is prevented from action by the coaction of the face 289 of the rotatable key 287 with the inner circumferential face of the hole 292 of the totalizer casing 133, when the resetting process is finished in the position according to Fig. 29. Accordingly, in this position the resetting shaft 192 is released for the return movement in the opposite direction of the arrow 290 (Fig. 29).

At this moment, the segment 269 has finished its swinging movement in the arrow direction 305, whereby the connecting rod 265 is in its second dead point position.

As soon as the engagement of the totalizer has taken place, the toothed sectors 136 and 137 (Fig. 15) are acted upon in the arrow direction 140 by way of the levers 118 and 113. Since the member 138 is attached to the toothed sectors 136 and 137 this member also travels in the arrow direction 140, whereby the noses 139 of the actuator sectors 19 are released and consequently the actuator sectors 19 are unlocked. In this operation the toothed segments 141 and 142 which are in engagement with the toothed sectors 136 and 137 are swung round the shaft 64 in the clockwise direction in which swinging movement the beam 76 projecting into the recesses 143 and 144 of the toothed segments 141 and 142 also participates.

In the swinging movement of the beam 76 in the clockwise direction round the shaft 64 the beam remains inoperative on the adjusting and indicating wheels 57, since these are in their normal or right hand position illustrated in Fig. 16.

In the rotation of the wheels 185 (Fig. 24) in the arrow direction 290, the segments and type-printing rods 19 (Fig. 20) are displaced in the arrow direction 140 by way of the toothed wheels 134a corresponding to the amount registered in the totalizer. Over-shooting of the zeroized wheels 185 (Fig. 28) in the arrow direction 290 is prevented by the previously locked tens transfer levers 194.

Now, in the rotation of the shaft 116 (Fig. 14) the roller 147 of the lever 148 slides from the raised part of the cam 149 to the lower part of the same, whereby the yoke 153, 154, 155 is swung round the shaft 156 in the anti-clockwise direction into the position illustrated by dotted lines by way of the parts 150, 179, 152 so that the type hammers 157 are released.

After one-half of a revolution of the main drive shaft 12 the coupling casing 102 and the mechanisms in connection with it have come to rest as above described under the chapter "Operation of the drive for the adding and printing mechanism."

Now the printing mechanism is actuated as described under the chapter "Operation of the printing mechanism."

As soon as the zeroizing of the wheels 185 of the totalizer located in the working position or the printing of the total has been effected, the nose 129 (Figs. 19 and 23) of the two-armed lever 130 slides off from the raised part of the cam 127, whereby the lever 130 is swung in the clockwise direction under the action of the spring 181. In consequence of this the totalizer frame arranged in the totalizer casing can now swing round the shaft 134 in the anti-clockwise direction under the action of the spring 187, the swinging movement being limited by the striking of the side part of the totalizer frame against the pin 188 arranged on the totalizer casing. In the swinging of the totalizer frame in the anti-clockwise direction round the shaft 134 the toothed wheels 134a are disengaged from the teeth of the racks 135, whereby the driving connection of the racks 135 with the totalizer located in the working position is interrupted.

As soon as the nose 129 of the lever 130 has again moved from the raised part of the cam 127 on to the lower part of the same, the cam 309 acts on the pawl 307 and swings the same round the pin 308 in the clockwise direction against the action of the torsion spring (not illustrated) whereby the horizontal arm of the pawl 307 moves out of the ring groove 306 of the shaft 125 and accordingly the shaft 125 and the parts 283, 124, 127 and 128 (Fig. 23) arranged on it, are moved back under the action of the spring 284 against the arrow direction 285.

Thereby the pawl 307 comes in engagement with the ring groove 314 of the shaft 125, whereby the shaft 125 and the parts 283, 124, 127, 128 (Fig. 23) fixed to the same are stopped in their return movement before said parts have come to their final home position. In this position the nose 129 of the lever 130 is in working position to the part 316 connecting the cams 127, 128 the radius of which part 316 corresponds to the lower part of the cams 127, 128.

In the swinging of the lever 278 in the anti-clockwise direction under the action of the spring 284, the face 312 of the part 311 also releases the key lever 4, whereby the key lever 4 under the action of its spring 86 is rocked round the screw 85 in the anti-clockwise direction into its position illustrated in Fig. 10, so that the coupling casing 102 again participates in the further rotation of the shaft 12 as above described under the chapter "Operation of the drive of the adding and printing mechanism."

For the remainder, the operations hereinbefore described occur for which reason these shall not be described further. Similarly the parts 158,

160, 161, 162, 147, 148, 149, 150, 152, 153, 154, 156 are returned to their rest position in the manner above described, under the chapter "Operation of the printing mechanism."

In said further rotation of the coupling casing 102 in arrow direction 22 the toothed sectors 136 (Fig. 15) and 137 during the second half of the revolution of the levers 117 and 114 are moved by way of the levers 118 and 113 through the intermediary of the parts 108, 112 in the opposite direction of the arrow direction 140, whereby the toothed segments 141 and 142 standing in engagement with the toothed sectors 136 and 137 are acted upon round the shaft 64 in the anti-clockwise direction, whereby the beam 76 is likewise swung in the anti-clockwise direction into the normal position.

Besides the actuator sectors 19 are naturally also brought back into the rest position by the beam 138 fixed to the toothed sectors 136 and 137 in consequence of its action on the noses 139 of the actuator sectors 19.

During said second half revolution of the parts above described, the pawl 307 slides upon the raised part 315 of the cam 309. During this movement the lever 130 is held in working position with regard to the part 316 of the cams 127, 128 by the co-action of the pawl 307 with the ring-groove 314 in the manner above described. Since the radius of the part 316 corresponds to the lower part of the cam 127, 128, the lever 130 may not be operated by the part 316 during this second half revolution of the machine parts including the shaft 125. Accordingly the wheels 134 of the totalizer do not come in engagement with the toothed sectors 135 of the printing sectors 19. Consequently it is not possible to bring the value which was cancelled in the totalizer again into the same by the above mentioned return movement of the printing sectors 19, which is effected during the second half revolution of the machine part.

Shortly before the completion of the second half revolution of the machine parts including the shaft 116 and the cam 309 fixed upon the shaft 116, the cam 309 acts with its raised part 317 upon the pawl 307 and rocks the same against the action of its torsion spring further in the clockwise direction. Thereby the pawl 307 comes out of engagement with the ring groove 314 of the shaft 125. Consequently, the shaft 125 and the parts 283, 124, 127 and 128 fixed thereon are moved back under the action of the spring 284 in the arrow direction 286 to the home position (Fig. 16). In this position the lever 130 is again in working position with regard to the adding cam 128.

As described under the chapter "Coupling and driving mechanism for total taking," the coupling of the shaft 240 with the cams 253, 257 for one revolution is effected, whereby on the revolution of the disc 257 the parts 265, 267, 268, 269 are also operated. Thereby the toothed segment 269 is moved back in the opposite direction of the arrow 305 during the second half revolution of the disc 257, whereby the same operates the toothed wheel 304 and therewith the resetting shaft 192. Thereby the wheel 304 and the resetting shaft 192 are moved back from the resetting position according to Fig. 29 to the home position according to Fig. 27. This is possible, since the lock 289, 291 may not be effective in the resetting position as described further above. The gearing parts of the totalizer including the number wheels 183, which are reset to zero position by the resetting shaft 192 do not take part in the return movement of the shaft 192, since the friction of their bearings and teeth are greater than the bearing friction of the shaft 192. At the end of the return movement of the shaft 192 in the opposite direction of the arrow 290 the face 288 of the rotatable key 287 is influenced by the cam 300 (Fig. 27) whereby the lock 289, 291 is again effected. In this home position (Fig. 27) the resetting shaft 192 cannot be rotated in the opposite direction of the arrow 290. At the end of said return movement of the parts 253, 257, 265, 268, 269, that is, after one revolution of the discs 253, 257 the coupling 252, 141 (Fig. 22) is again released as described under the chapter "Coupling and driving mechanism for total taking." In the home position of the segment 269 (Figs. 20 and 27) which is attained by return movement of the same, the bridge 271, 273 is again released from the part 274 of the segment 269, whereby the lock 194 described above for holding the tens transfer lever 190 is again released.

Shortly before the completion of a revolution of the coupling casing 102 (Fig. 10) the nose 93 of the coupling pawl 94 acts on the nose 101 of the part 98 which as has already been mentioned after the release of the addition key 84 was moved with its nose 101 into the path of movement of the nose 93 of the coupling pawl 94. In consequence of this, the coupling pawl 94 is swung around the pin 105 in the clockwise direction against the action of the spring 103 so that the nose 106 of the coupling pawl 94 moves out of engagement with the cam 107, so that the coupling casing no longer participates in the revolution of the main drive shaft 12 and the mechanisms are held in their rest position.

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16 Sheets-Sheet 1

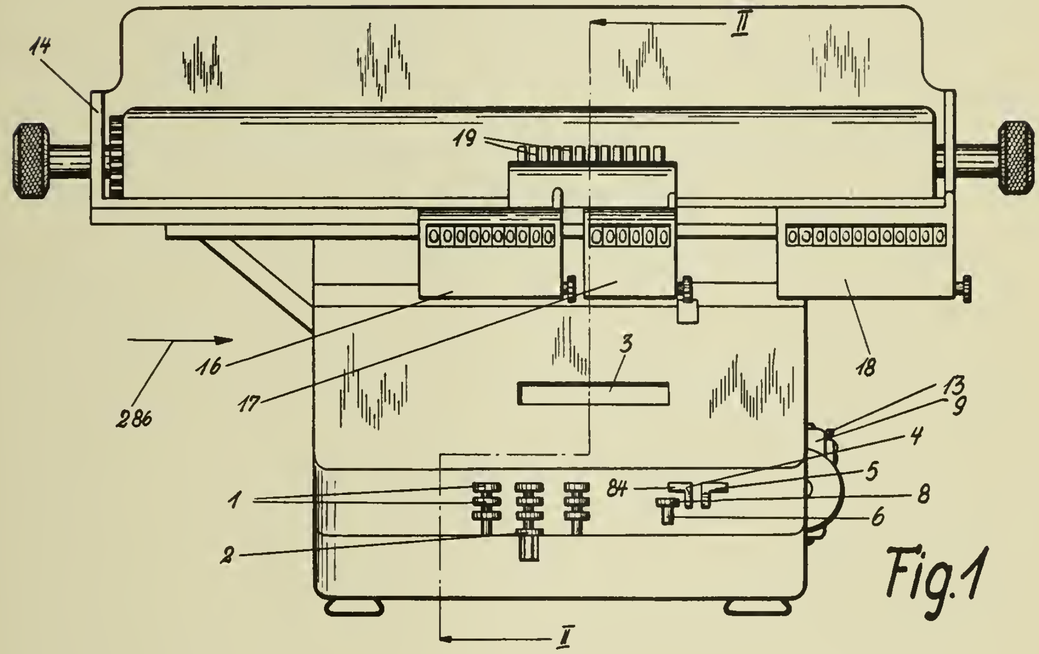
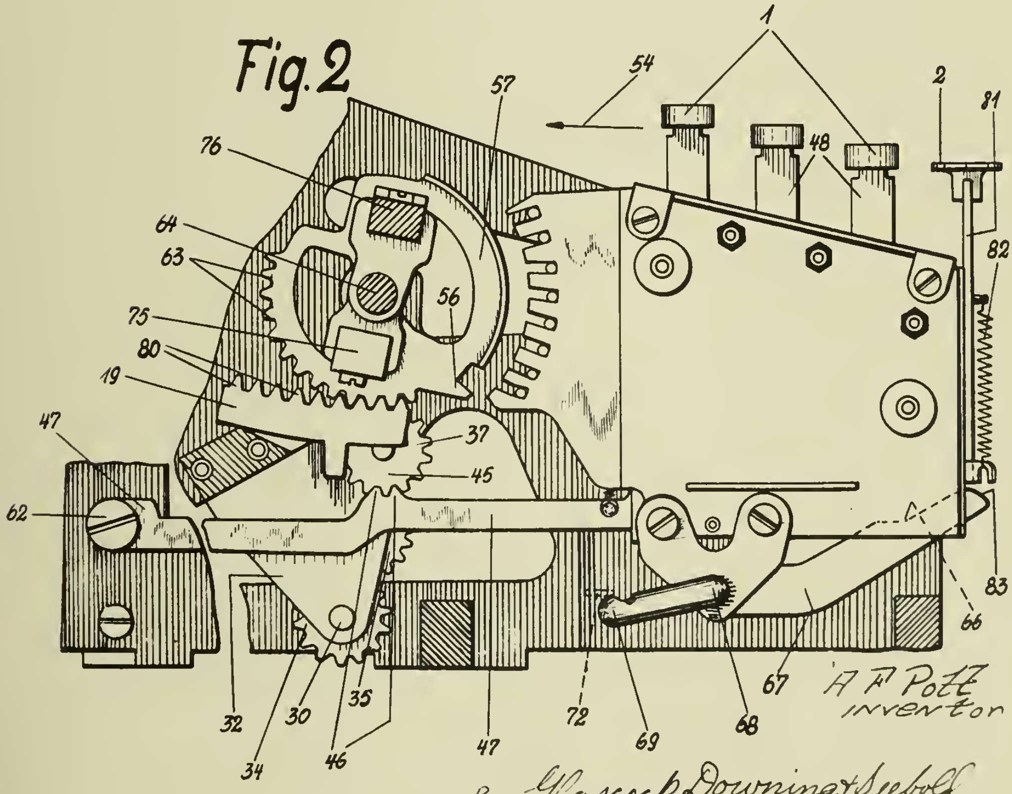


Fig.1

Fig.2



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Att'ys

PUBLISHED

MAY 25, 1943.

BY A. P. C.

A. F. POTT
CALCULATING MACHINES, CASH
REGISTERS OR THE LIKE
Filed Dec. 29, 1937

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182,336

16 Sheets-Sheet 2

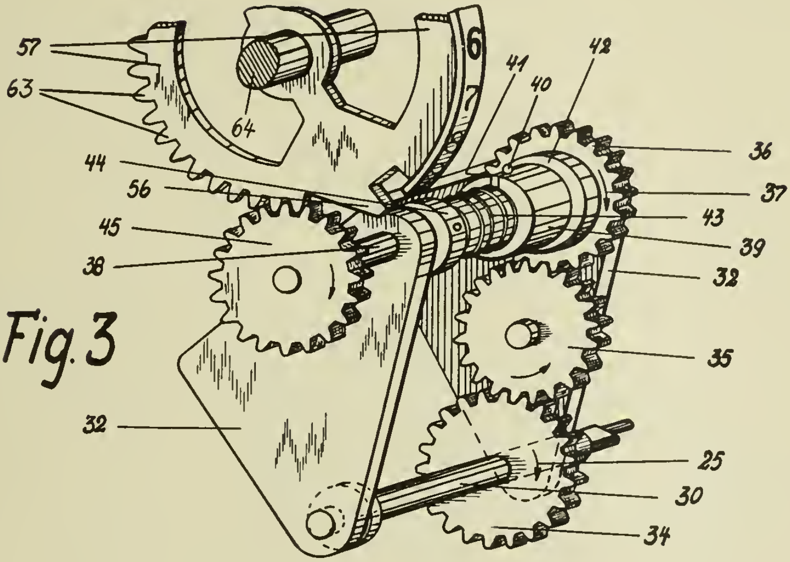
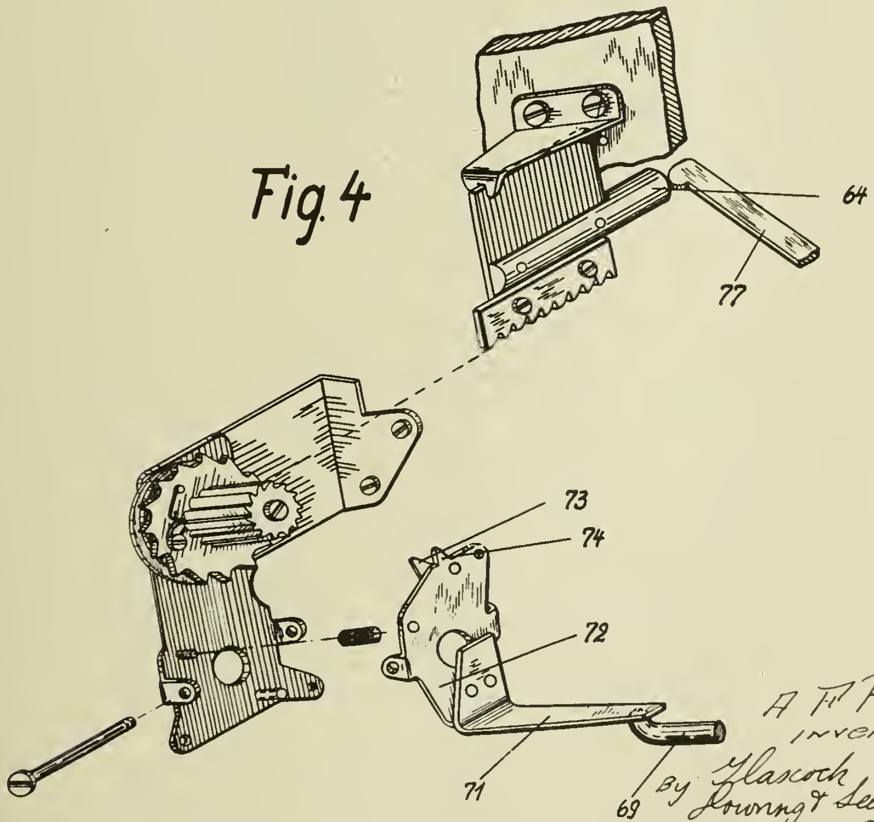


Fig. 3

Fig. 4



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Serial No.
182,336

16 Sheets-Sheet 3

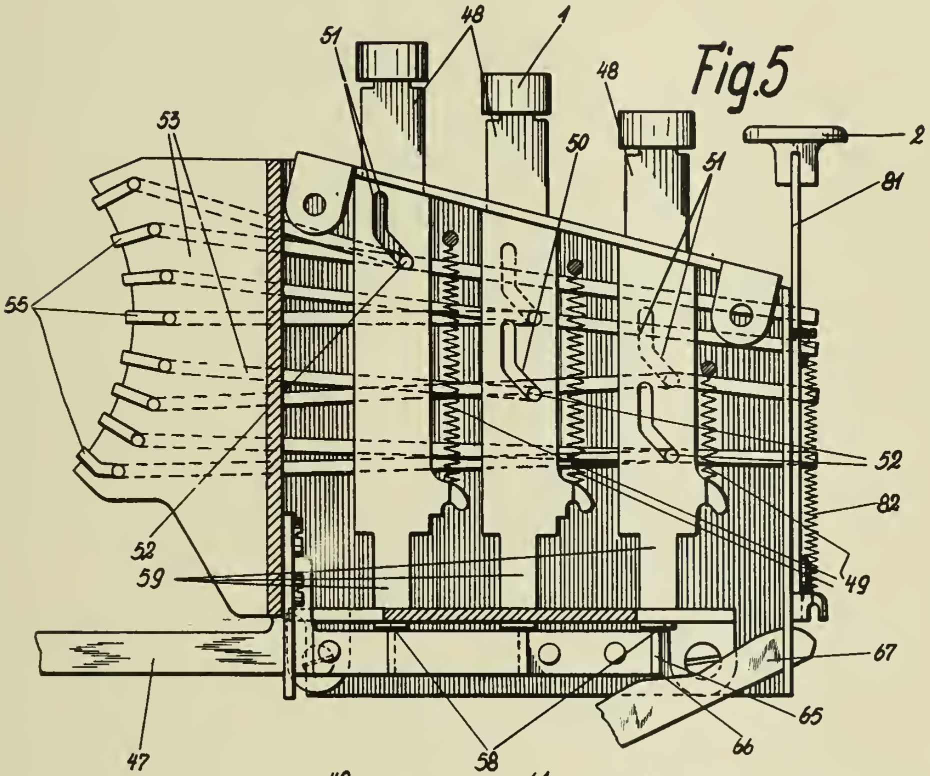

Fig.5

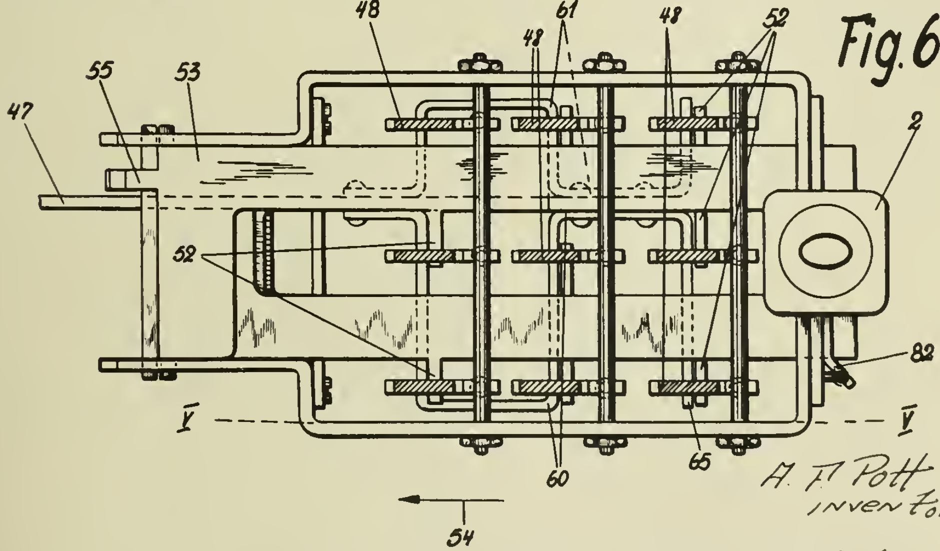

Fig.6

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182,336

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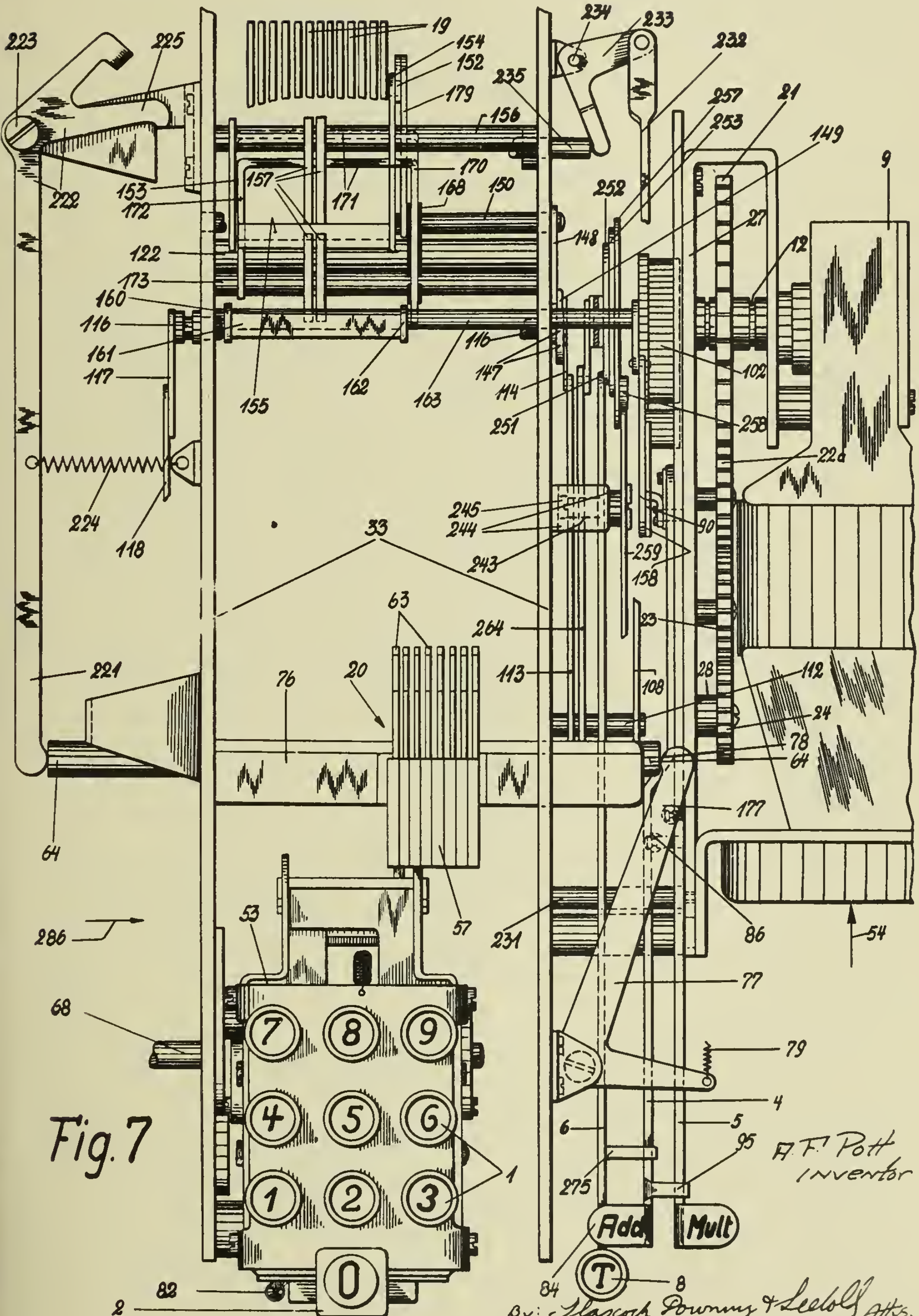

Fig. 7

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182,336

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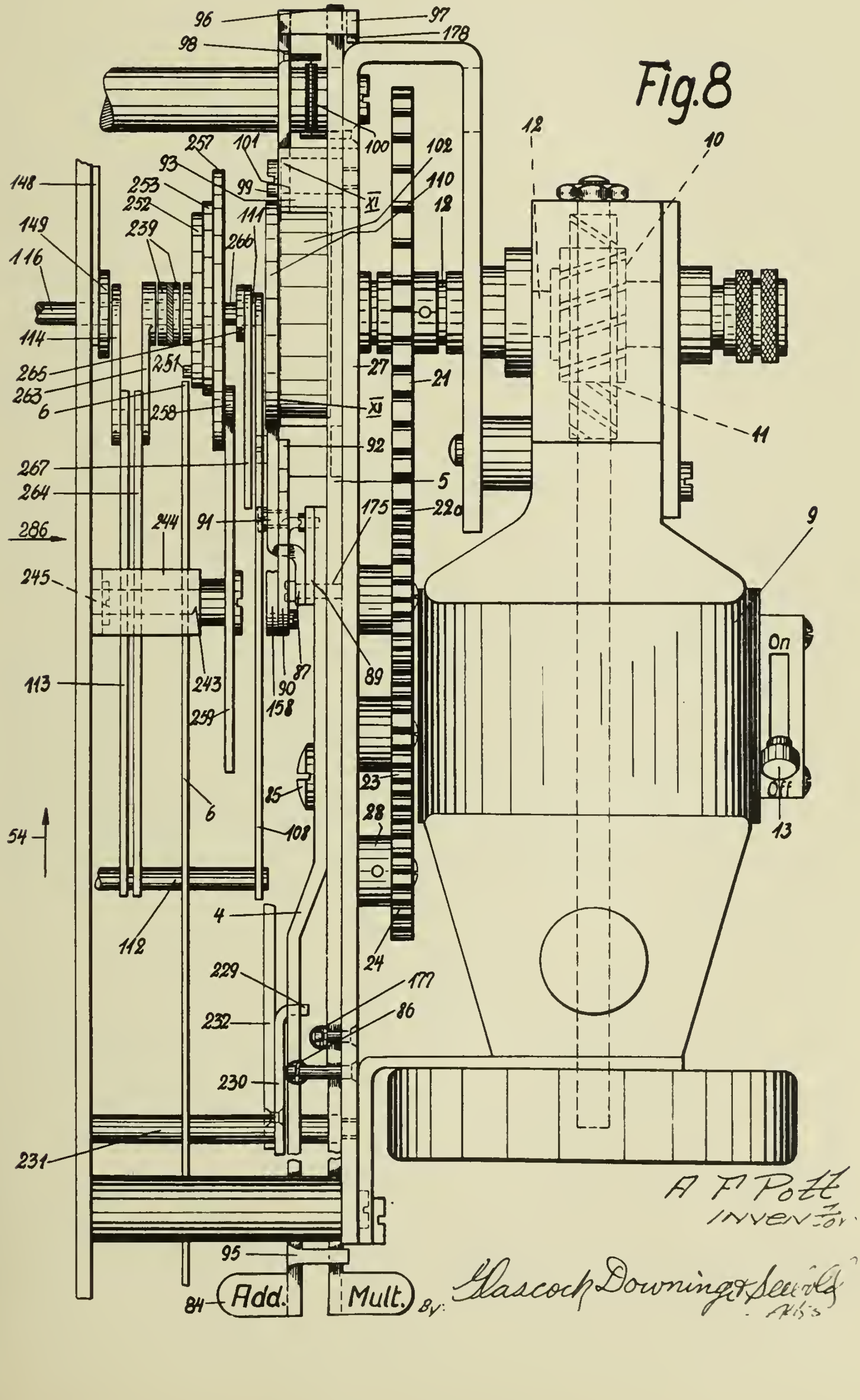
Fig.8



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182,336
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Fig. 9

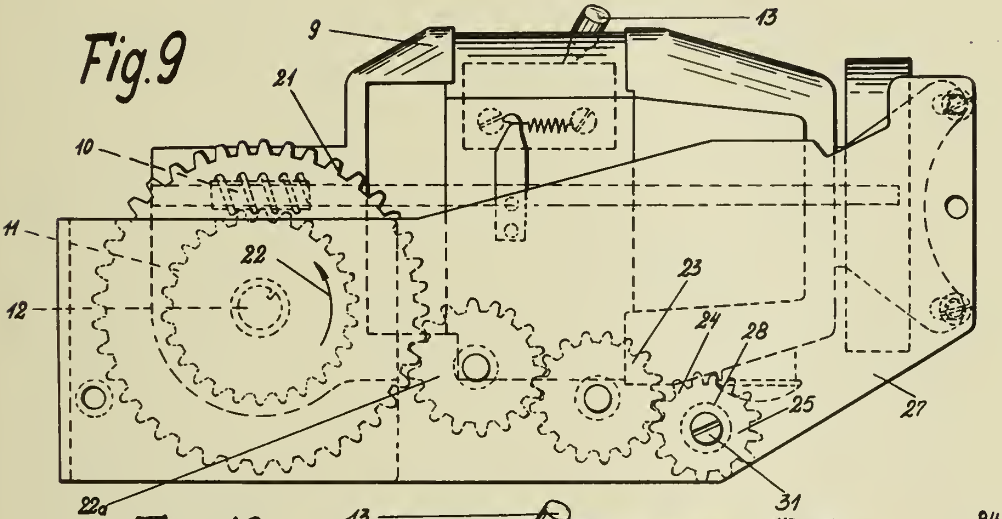
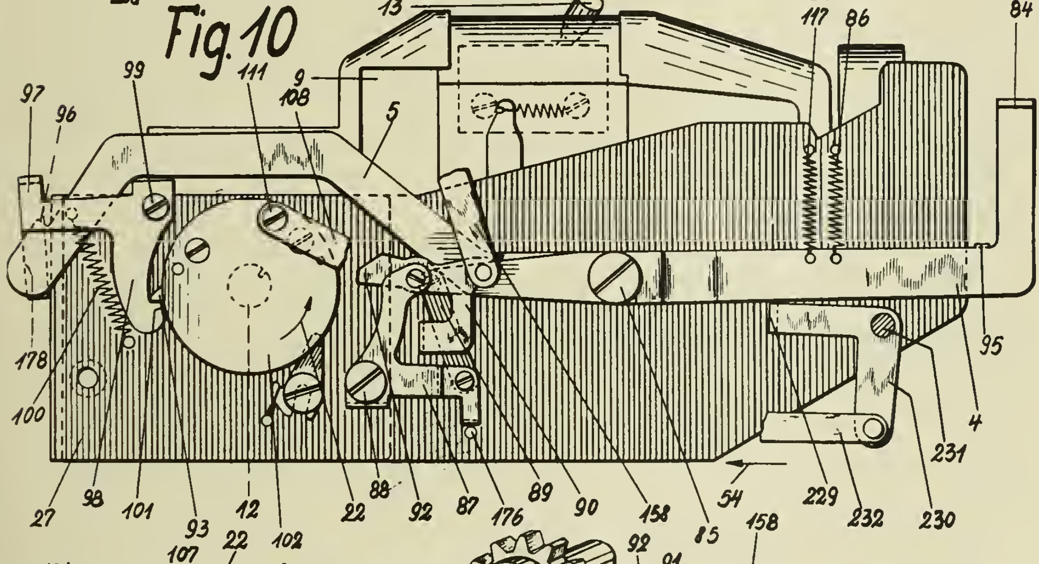


Fig. 10



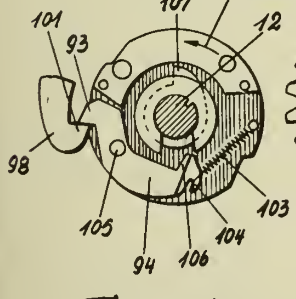


Fig. 11

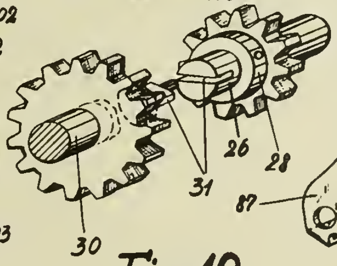


Fig. 12

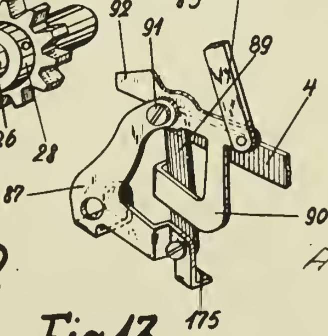


Fig. 13

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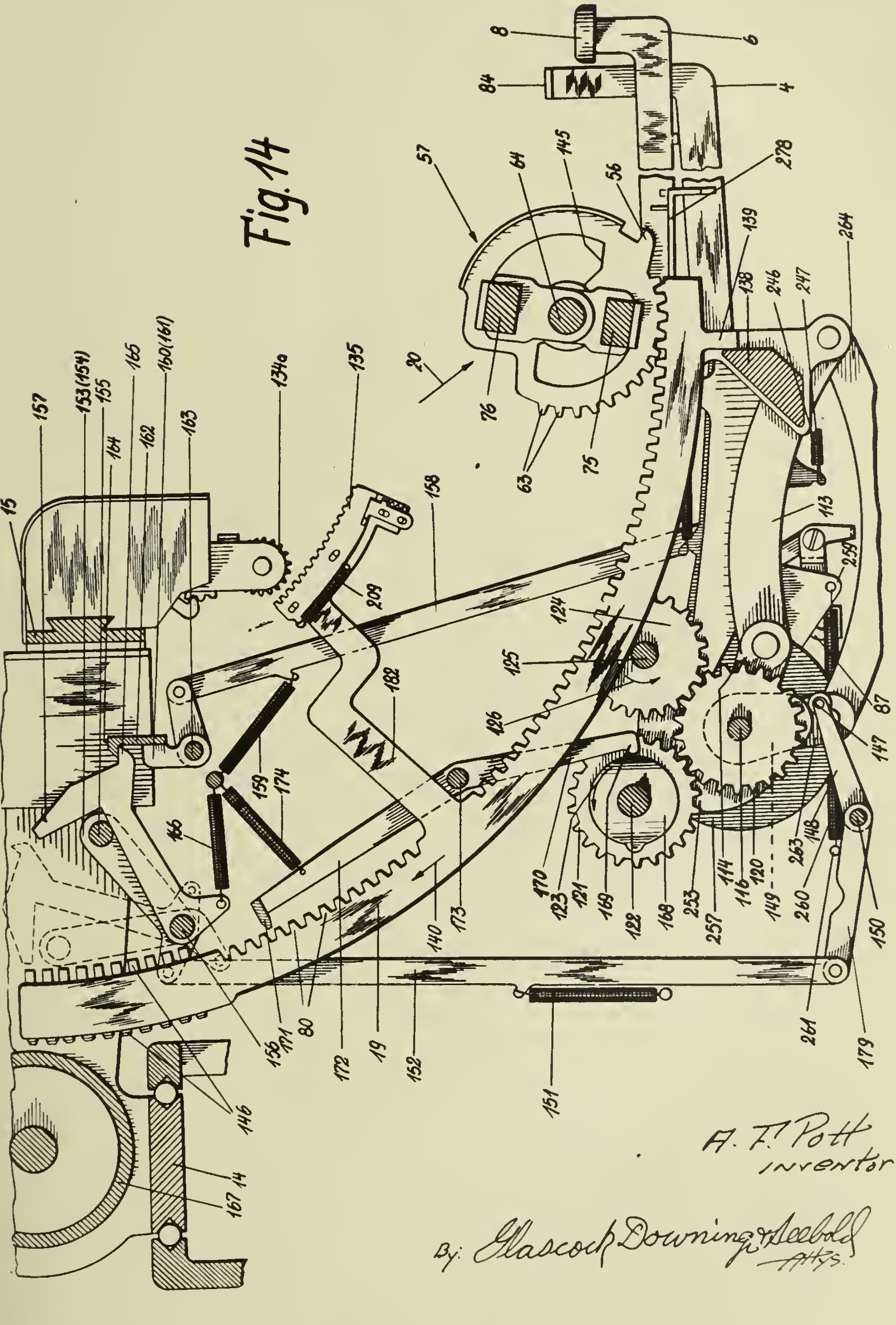

Fig. 14

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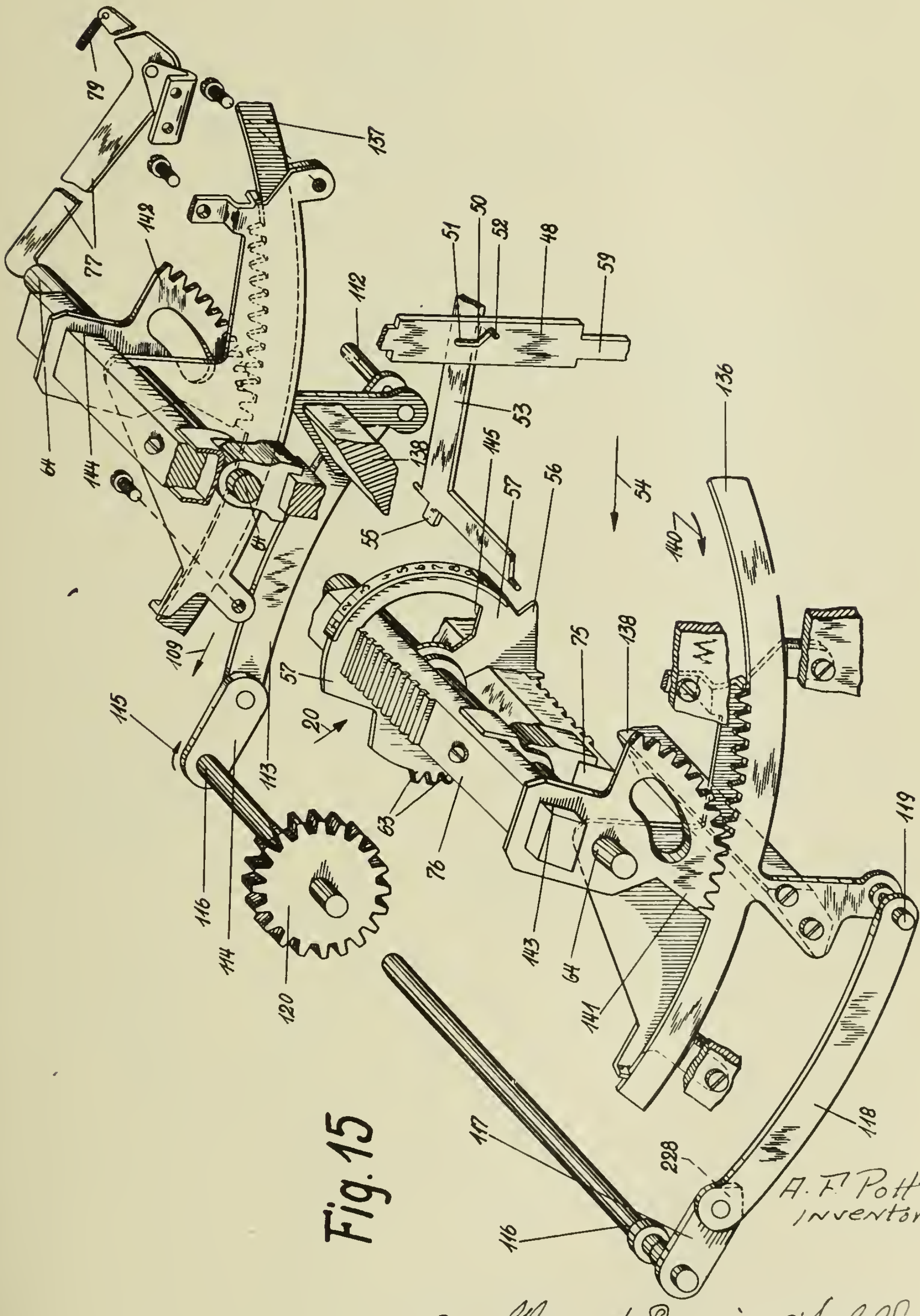

Fig. 15

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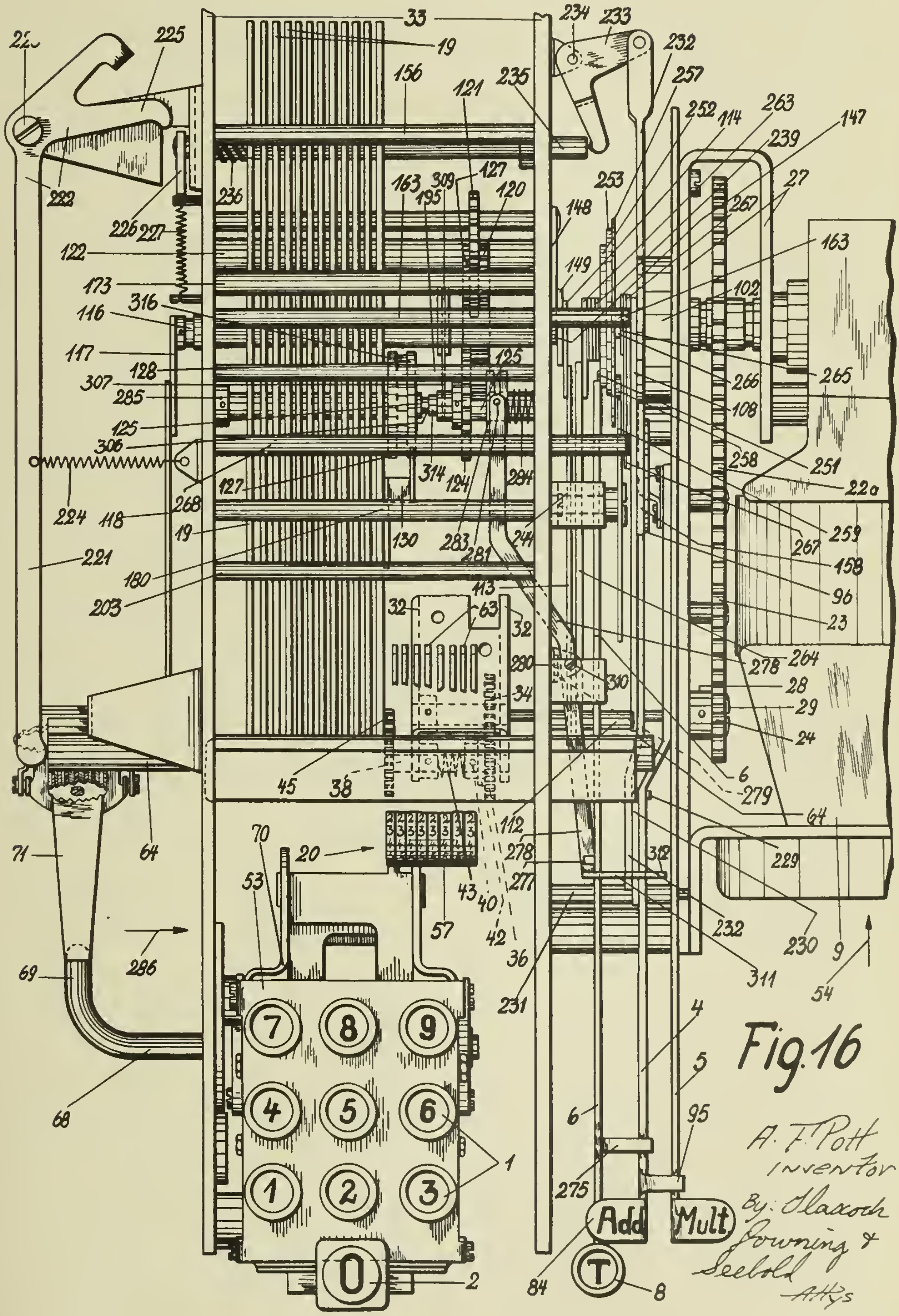

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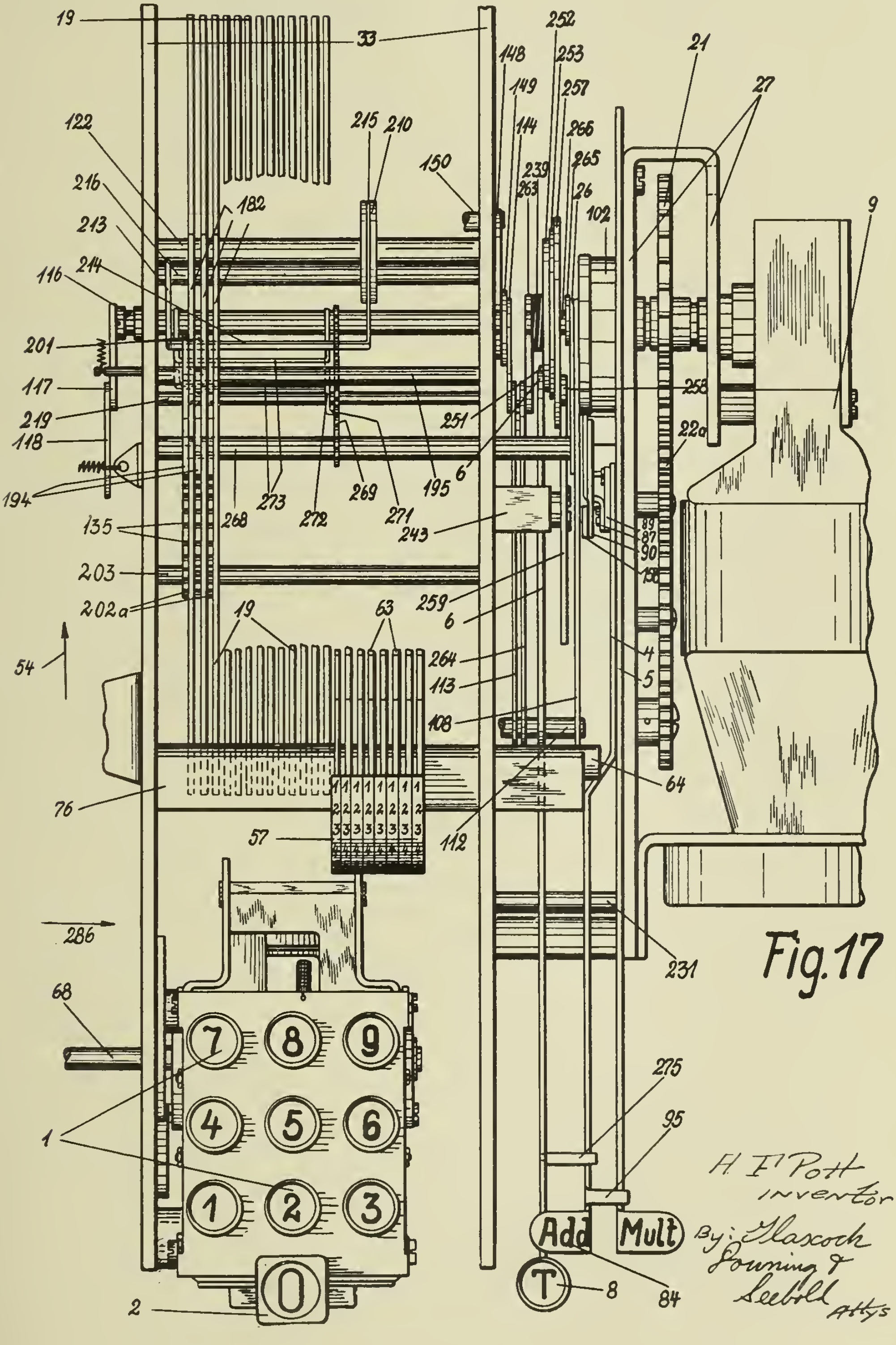

Fig. 17

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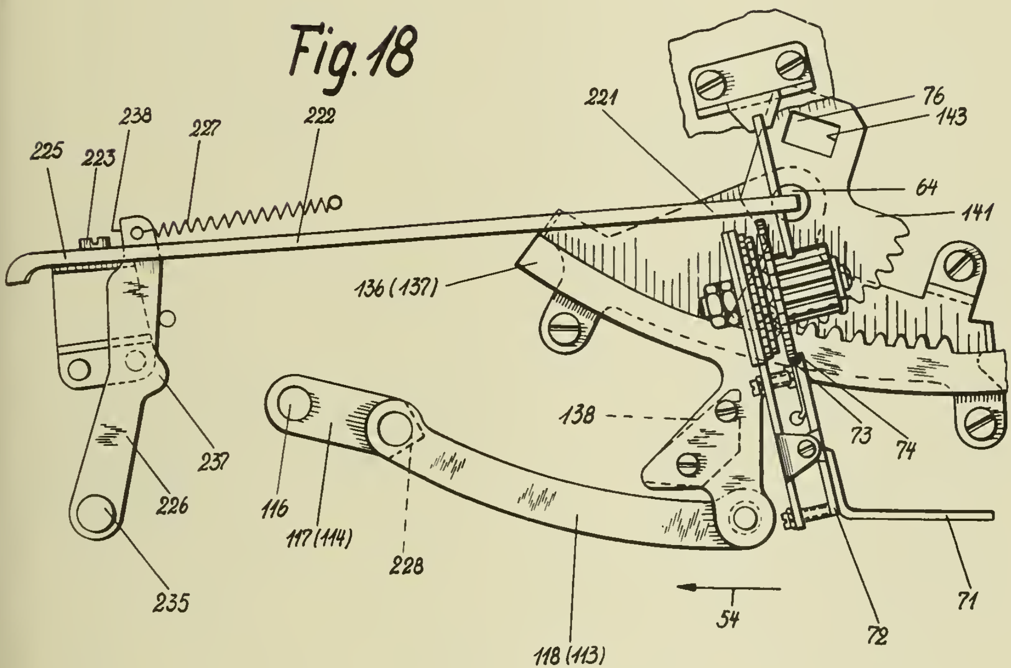
Fig. 18



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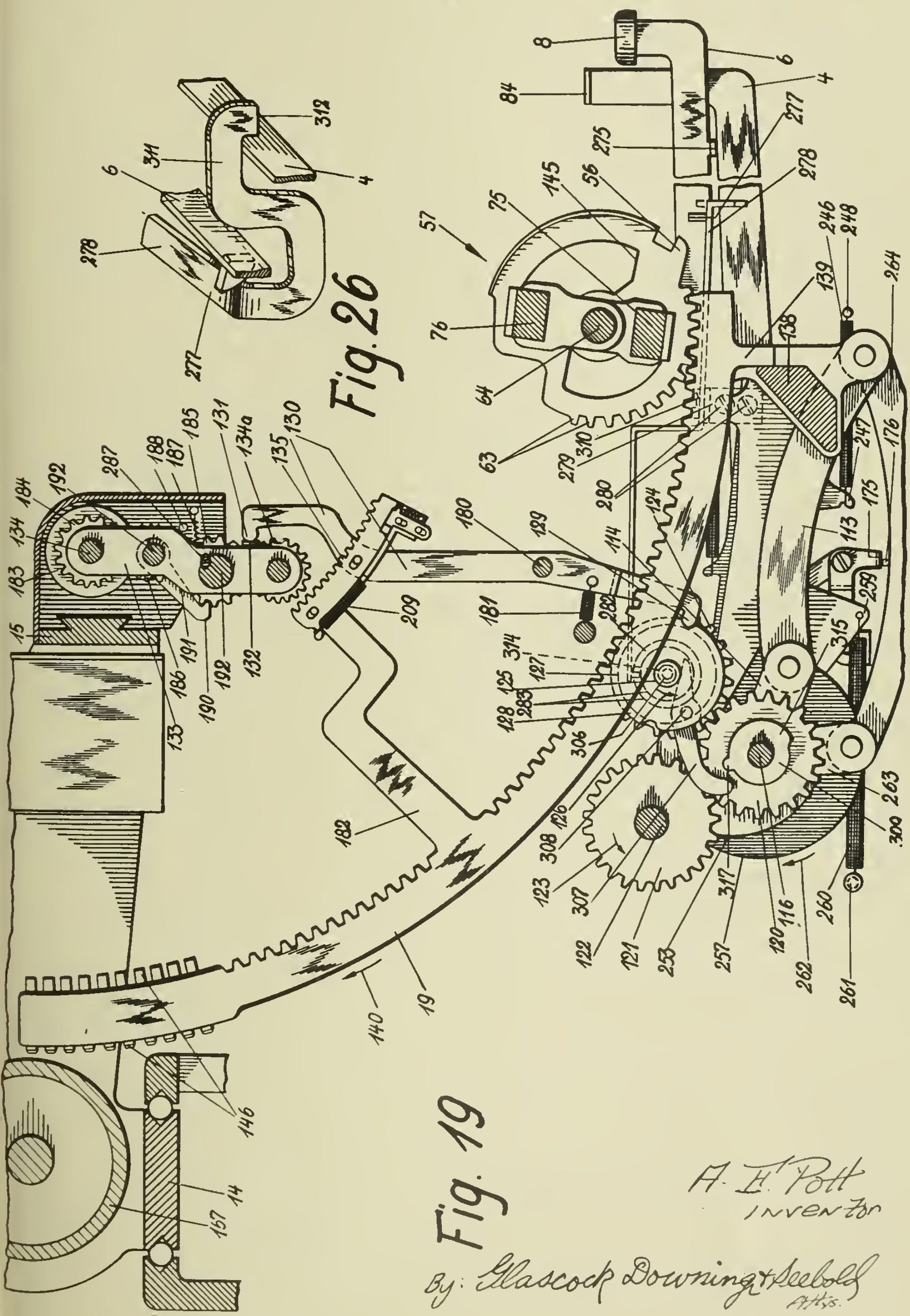

Fig. 26

Fig. 19

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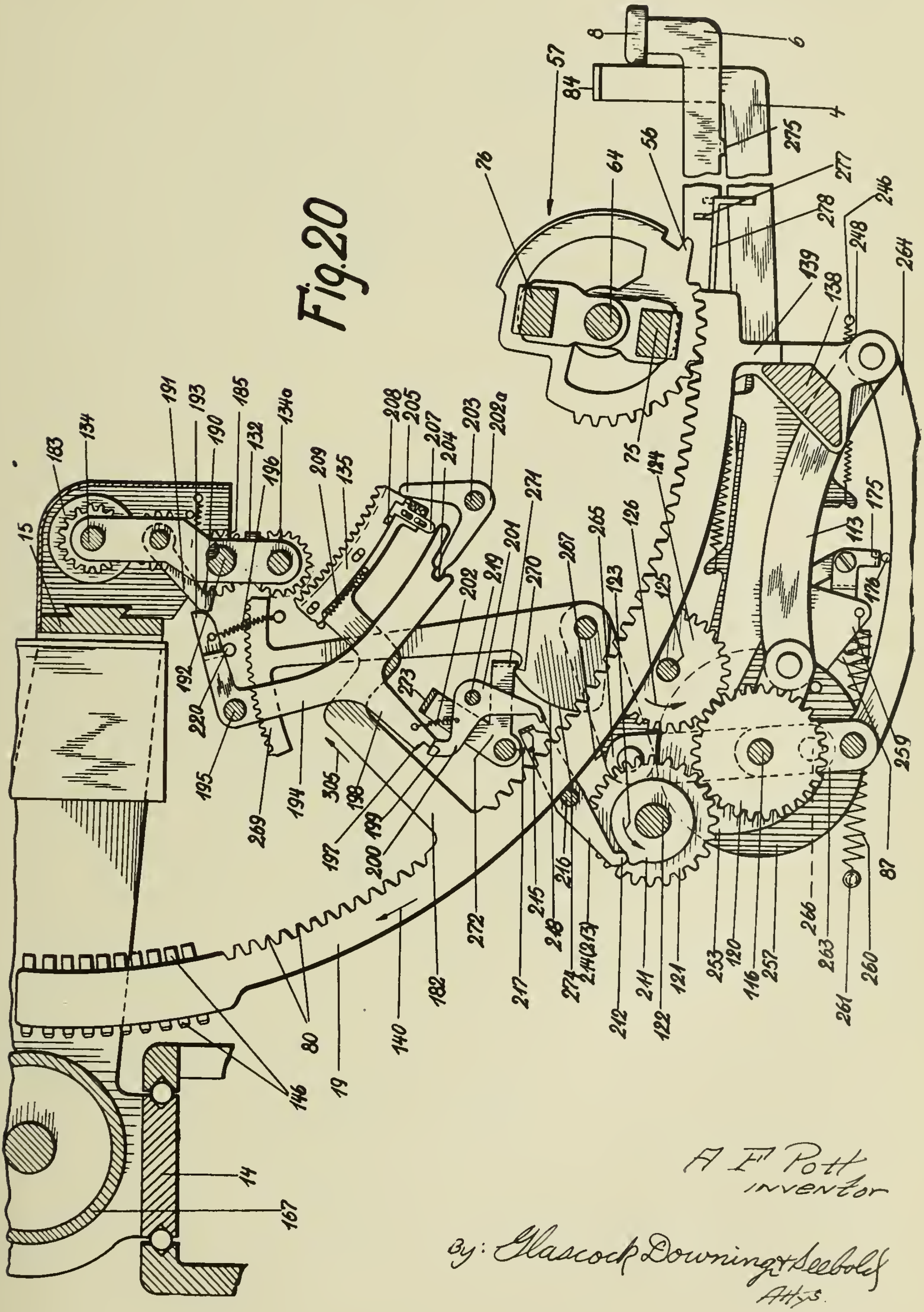

Fig.20

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Fig.21

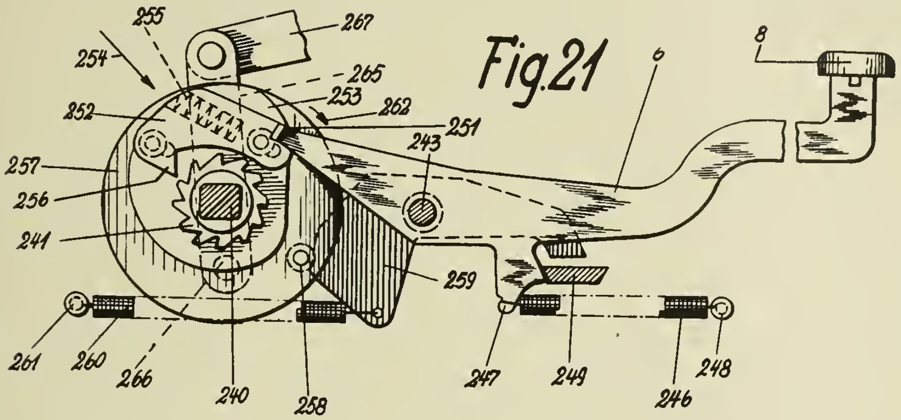
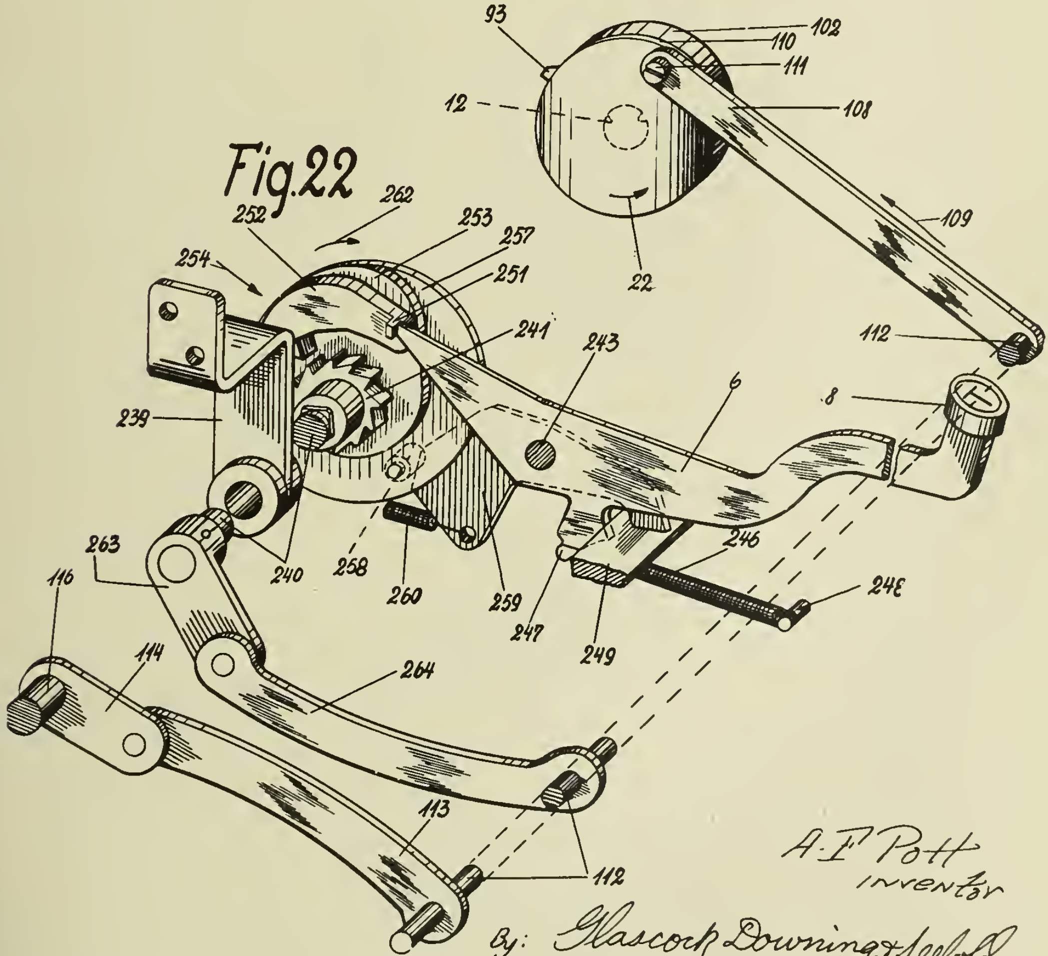


Fig.22



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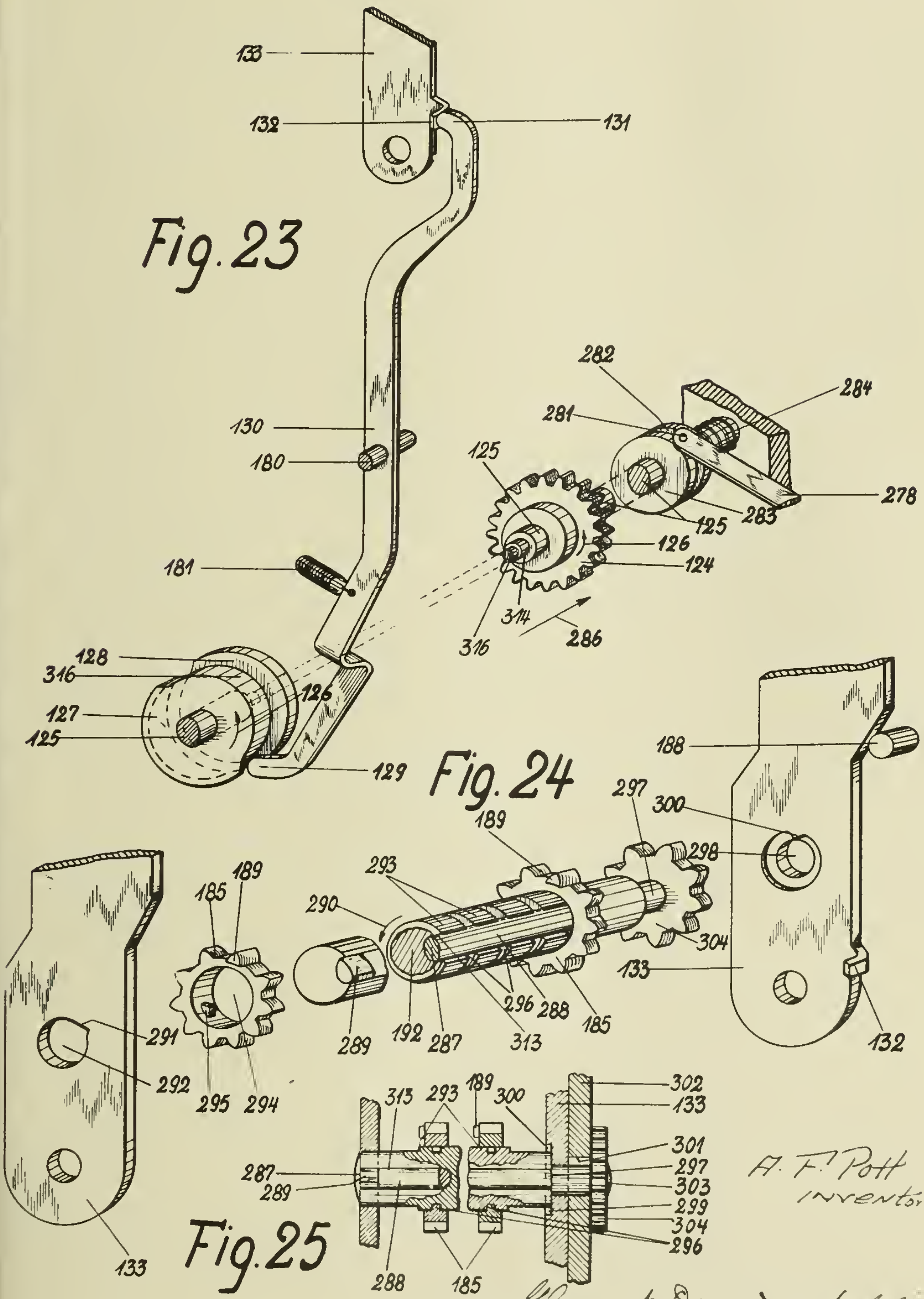

Fig. 23

Fig. 24

Fig. 25

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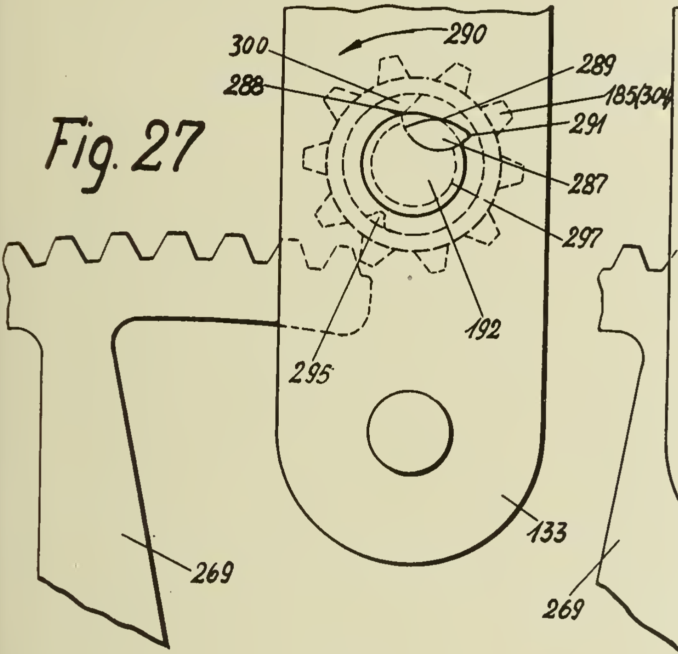

Fig. 27

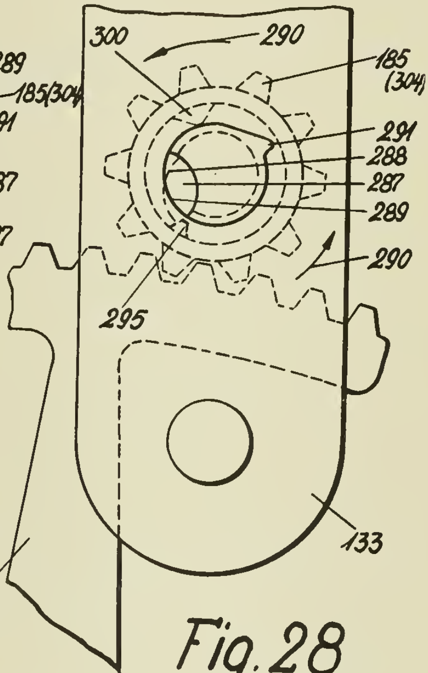

Fig. 28

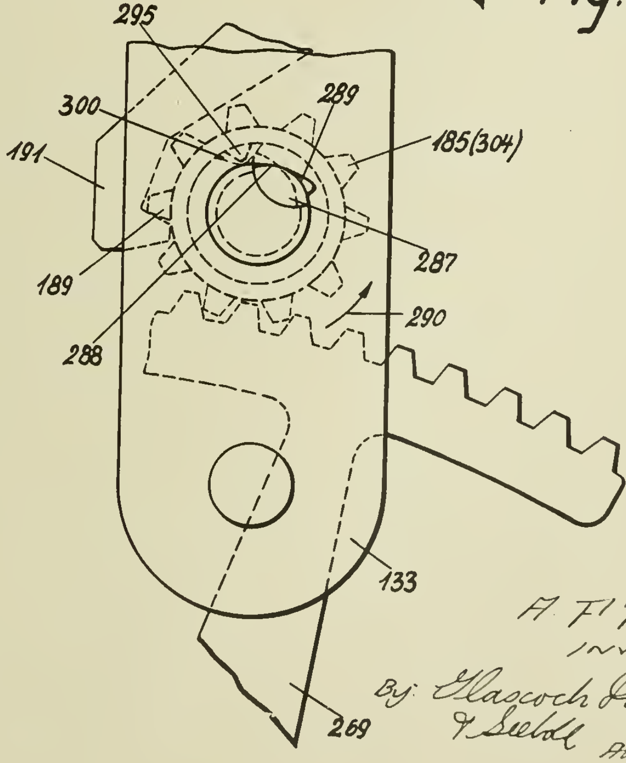

Fig. 29

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ALIEN PROPERTY CUSTODIAN

FILTER MATERIAL

Walter Harz, Dormagen (Kreis Neuss), Herbert Rein, Leipzig, Emil Hubert, Dessau-Ziebigk and Carl Kayser, Bitterfeld, Germany; vested in the Alien Property Custodian

No Drawing. Application filed January 5, 1938

Our present invention relates to filters for industrial purposes.

Large scale filtration of strong acids, alkalies, or solutions of oxidizing action has always presented difficulties because filter layers suitable for this purpose easily obtained and of sufficient mechanical strength such as are available in the form of fabrics or wadding-layers of natural fibers in the case of neutral liquids have not been at the disposal of the manufacturer.

It is an object of the present invention to provide filter layers which are suitable for filtration on an industrial scale.

A further object is the provision of improved filtering cloths or plates and the like, which are stable against acidic, alkaline, or oxidizing chemicals.

A further object has to do with the provision of an inexpensive and lasting material of high mechanical strength.

Other objects of our invention will become apparent to those skilled in the art after a study of the following specification.

We have discovered that a generally applicable filtering material for liquids of strongly acidic, alkaline or oxidizing action may be obtained by using fabrics, fleeces or felted layers of threads from artificial resins of polymeric hydrocarbons or their chlorinated derivatives or of mixed polymerizates of these substances. Such artificial materials are for example polystyrene, polyisobutylene, polyvinyl ether, mixed polymerizates from styrene or polyisobutylene and vinyl ethers, chlorinated rubber, polyvinyl chloride, after-chlorinated polyvinyl chloride or mixed polymerizates from vinyl chloride with other compounds capable of polymerization such as styrene, polyisobutylene, vinyl ethers and vinyl esters.

The manufacture of fibers and threads from these artificial substances is known and practised on a large scale. Reference is here made to U. S. Patent Applications Ser. No. 638,388 filed October 18, 1932 and Ser. No. 118,916 filed January 2, 1937 where the method of producing suitable threads from polyvinyl resins is disclosed (compare also British Patent No. 387,976).

As filter layers fabrics may be used consisting of threads, felts, slivers or loose layers of continuously spun artificial fibers or such as has been made from artificial staple fiber cut or torn from such continuously spun material.

Especially suitable for industrial purposes are filter cloths which may be used in filter presses. These cloths must be closely woven from threads of artificial polyvinyl resins. They have the special advantage that in most cases no frames are necessary, since a stiffening of the edges of the filter cloths may be obtained by heating and pressing the marginal parts.

From the above mentioned fiber fleeces and felted layers there may be obtained bodies permeable to liquids and gases. By applying pressure and heat to the fiber fleeces or felted layers these are formed into more or less rigid articles which may possess the shape of plates, tubes, cardboard sheets etc. The rigid and stiff filter plates thus produced may be employed as diaphragms for electric cells. Their porosity may be adjusted at will by changing the thickness of the layers, by altering the amount of pressure and the height of temperature or by incorporating with the layers solid bodies which are capable of being again removed after the shaping operation. To the material from which these sheets are formed there may be added before the working up thereof fillers which are stable against alkalies and acids such as for instance barite, kaolin, graphite and similar masses. In order to stiffen the sheets or diaphragms, rods, wire-nettings or suitably formed work pieces from chemically indifferent materials may be incorporated with the compressed masses. If desired, suitable plasticizing agents may be added to the artificial resins.

Filter layers made from such materials are well suited for filtering acids, alkalies and oxidizing liquids as well as others which attack the usual filter layers. They constitute therefore a universally applicable material for filtration of chemically active liquids. They are stable against concentrated alkali such as potash and soda lye, concentrated acids such as hydrofluoric acid, hydrochloric acid, phosphoric acid, sulfuric acid or aqua regia. Also to chlorine liquors, hydrogen peroxide, cuprammonia solution or to the other liquids which destroy known organic or inorganic filtering materials. They are inapplicable only for organic liquids which have a solvent action on the artificial material in question.

The following examples serve to illustrate the invention. The invention is, however, generally applicable and not limited to the specific details set out in the examples.

Example 1.—A card fleece of sufficient thickness from polymerized vinyl chloride is pressed to yield a permeable but still comparatively dense foil at a moderate temperature so that the fibers are slightly softened by the pressure but do not melt. If in this case pressing matrices or pressing rollers are employed which have the surface patterning of the usual filtering papers, papers

are obtained which do not externally differ from the usual cellulose filtering papers. The filtering papers from polymerized vinyl chloride thus produced are absolutely stable against acids and alkalies.

Example 2.—Fibers from mixed polymerizates from 80 parts of vinyl chloride and 20 parts of acrylic acid methyl ester, which fibers are obtained according to the aforementioned U. S. Patent Applications Ser. No. 638,388 and Ser. No. 118,916 (British Patent No. 387,976), are ground in a rag or pulp engine, if desired with addition of wetting agents and protective colloids. From the paste of fibers thus produced a foil is formed according to the methods of the paper and cardboard making industry. After drying and compressing in the cold this foil is calandered from both sides in the warmth. A filtering material is obtained which externally resembles the usual filtering papers and which is used in the same manner as the hitherto known cellulose filtering papers.

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Published May 25, 1943

Serial No. 192,177

ALIEN PROPERTY CUSTODIAN

PROCESS AND APPARATUS FOR THE RECLAIMING OF USED LUBRICATING OILS

Giacomo Bottaro, Genoa, Italy; vested in the Alien Property Custodian

Application filed February 23, 1938

It is known that it is sufficient to separate from used lubricating oils the insoluble oxidation products and other mixed impurities, so as to render them again ready for use.

This reclaiming is made a great deal through a filtration or by means of centrifugals and the results thus obtained are useful up to a certain grade. The filtration gives better results but it is rendered difficult on account of the semisolid or colloidally dissolved oxidation products or highly dispersed carbon, and therefore one is obliged to make use, in order to be able to achieve such filtration, of filter aids such as fullerearth, asbestos-fiber or asbestos-powder, sawdust and the like in order to make the filtration possible. Of course these filter-aids adsorb also the oil which is therefore partially lost.

It has now been found that better results with a higher yield and in a much more simple way can be obtained if the used lubricating oils are submitted to a sweating process. In this way the impurities and the semisolid oxidation products are removed even better as through the use of filter-aids, while the apparatus for the putting into practice of the process are so simple that they can be actioned semi or fully automatically with a total saving of assistance and labour.

The present invention refers to this sweating process for used oils as well as to the means and apparatus which allow this sweating process to be put into practice.

To this purpose the used oil is put into devices of different construction which contain special separation elements, the porous surfaces of which possess the property to adsorb and to retain firmly the semisolid axidation products, the so-called "asphalts". The coating that forms itself on the surface adheres so closely to them that same cannot be removed by mechanical means. In this way an actual compound is formed between the "asphalts" and the surface of the porous wall which form together a diaphragm which has the property to function as a skin, so that the bright oil is first absorbed by said diaphragm and proceeds further into the inside of the porous wall, wherefrom it runs out in the open. All impurities, as for instance, colloidal coal, dust and other quantities of asphalt are caught by the asphalt-porous-surface-diaphragm, which adsorbs also in all likelihood substances which are dissolved colloidally in the oil, the so-called oilrosins, at least those which possess a high molecular weight.

When the diaphragm is formed and when no pressure is used on same, it impedes also that the asphalt proceeds further into the inside of the porous wall, so that the sweating goes through a relatively attenuated layer of asphalt combined with the surface the porous wall.

This diaphragm has also the property to break the oil-in-water emulsions and the greater quantity of the water is also kept back while a part of the disemulsioned water can pass through the diaphragm. Therefore the action of this diaphragm can be compared completely with that of a skin and the process to the phenomenon of a sweating. A pressure or a vacuum do not help in the case; on the contrary, as already said, the diaphragm is damaged because it becomes thicker on account of the fact that the asphalt particles run deeper into the porous wall with the result that the sweating is rendered more difficult, because the bright oil has to run a longer way through the diaphragm. As indicated by these facts, the process is totally different from a filtration and therefore same has been called for reasons of analogy and to indicate its purpose "sweating process".

The materials which form the porous surfaces are those which have an adsorption property towards the so-called asphalt or show in any way a property of attraction for it. This phenomenon is probably based on the existence of electrical charges having opposite signs. The materials that come into consideration are the following: tissues of asbestos, of glass, of nitrated or acetylated cellulose and as last: vegetable fibers. Also porous stones can be used. Wool or animal hair cannot be employed for the purpose. Asbestos qualities best and in the present description only the term "asbestos" is going to be used, which will comprise also all other materials suitable for the sweating process. Tissues of asbestos or glass are preferred because same are chemically inert and have a very long duration, so that the porous walls may last for years without need of changes.

The process presents the utmost important advantage that the sweating surfaces do not require to be changed, and therefore the apparatus in which they are disposed shall never be opened and are allowed to work continuously, with the only proviso that used oil is fed without interruption and that the excess of impurities separated on said surface is removed from time to time. As we shall see hereinafter, the apparatus are constructed correspondingly in order to remove substances without the necessity of opening the apparatus or to interrupt the sweating process.

These apparatus can also be built following the

known constructive forms of filtration apparatus, but as already said, it is the purpose of the present invention to indicate new forms of construction which allow to realize the following advantages:

1°—the fact that the sweating surfaces never need to be changed;

2°—the fact that the apparatus can work without any interruption with no need of opening them and stopping therewith the reclaiming process;

3°—the fact that there is no need for assistance and labour for the working of the apparatus.

In the annexed drawings the principle is illustrated and herewith only by way of example a few forms of construction of apparatus for the realisation of the present invention are presented.

Fig. 1 represents a vertical section of part of a sweating element where the separated layer of asphalt can be noticed.

Fig. 2 represents a schematical vertical section of an apparatus showing two sweating candles.

Fig. 3 represents on a larger scale a vertical section of a part of a candle, together with a special device pertaining to the candle. This section is carried perpendicularly to the section of Fig. 2.

Fig. 4 represents a vertical section of another device which serves to realize the process concerning the present invention.

Figures 5 and 6 show two vertical opposite sections (V—V of Fig. 6 and VI—VI of Fig. 5) of the upper and inferior part of another device pertaining to the invention.

Fig. 7 shows an horizontal section (VII—VII of Figures 5 and 6; in Figures 5 to 7 several details are left out for the sake of clearness.

Figures 8 and 9 show on a larger scale the shape of an element of the device following Figures 5 to 7, sidewise and on a sectional view (IX—IX of Fig. 6).

Figures 10 and 11 represent on a ground-plan respectively the cleaning elements when working and when at rest.

Figures 12 and 13 show on a vertical section (XII—XII of Fig. 11 and XIII—XIII of Fig. 10) said cleaning elements and means to remove them from, or to approach them to the sweating surfaces.

With special regard to Fig. 1, represents 1 the porous medium having a thickness s, 2 the used oil to be sweated, 3 the compounded layer of asphalt having a thickness t; the sweating unit in therefore formed by the combination of sweating diaphragm 3, its support 1, said unit having therefore a thickness $S=s+t$.

The layer 3 is formed at the beginning of the process. When this layer is formed and a new particle of the used oil comes into contact with a point of layer 3 in the direction of the arrow 4, the layer 3 absorbs first the bright oil and cedes it further to the porous wall; as already said the porous wall 1 possesses a property of adsorption for the substances which form layer 3, so that these substances cannot penetrate the porous wall 1 if no pressure or vacuum is applied.

As can be seen, the side 5 of the porous wall 1, from which the bright oil comes out, is so shaped that the oil can flow with no hindrance. In this way it is excluded that the sweated oil may exercise a reaction which could prevent or render more difficult the normal course of the sweating. The porous wall 1, as said before, can be made of asbestos or glass tissues or out of porous stones or tissues of vegetable fibers.

Following the viscosity and the nature of the sweating oils, a more or less energetic heating of the used oils is provided for.

The apparatus of Fig. 2 contains two candles 6 which are inside of a tank 7, which is isolated through an insulating medium 8. In the inside of tank 7 electrical resistances 9 connected with an electrical circuit 10 are placed; 11 is a regulator for the electrical current, which is intended to keep the temperature inside of the apparatus at a determined degree. The used oil is fed in the inside of candles 6. These candles are kept on place through devices which are schematically indicated through 12.

The sweating process goes in the direction of arrows 13 through the sweating layers and through the walls of the candles 6, i. e. from the inside to the outside of said candles. In this way the impurities remain on the surface of the inside wall of the candles and the bright oil pours in drops out of the surface of the outer wall and falls in the tank 7 wherefrom it flows through the pipe 14 in the container 15.

The layer (3 of Fig. 1), constituted out of the impurities that in the case of Fig. 2 are depositing on the inside surfaces of the candles, gets always thicker and therewith the intensity of the sweating slows up. It is therefore necessary to remove the excess of these impurities whereby it is necessary to take care that a layer 3 of a certain thickness remains adherent on this inside wall.

To this purpose (Fig. 3) means are provided for, which are constituted principally of a piston 16—17—18, which has a cylindrical wall 17 and which is attached through the arms 18 and the shaft 29 to an endless chain 19, which runs over the pulley 20 carried by shaft 21 which is supported by the supports 22. The crank 23 provides for the motion of the parts just described. The chain 19 runs inferiorly over the pulley 24 which is adjusted in the inside of the candle and which is mounted on shaft 25.

The bottom 16 of the piston has a central opening 26, which can be closed by disk 27 which finds itself underneath and which is movable along the shaft 29. Disk 27 has a larger diameter than opening 26. The weight of disk 27 is so chosen to allow such an operation as described further below. Disk 27 rests on ring 28 on shaft 29. That part of the chain 19 which runs from the lower pulley 24 to the upper pulley 20 goes through another opening 30, which is provided at the bottom 16 of the piston.

The lower end of each candle terminates in a pipe 31, which carries the valve 32 through which the separated impurities fall out in the container 33.

The operation of the device following Fig. 2 and 3 is as follows:

Piston 16—17—18 rests usually at the upper end of the candle; disk 27 rests on ring 28, the opening 26 is free; the used oil is allowed to flow in the direction of the arrow 36 towards the bottom of the candle. When the excess of the deposited impurities on the inside of the wall of the candle must be removed, piston 16—17—18 is pushed by means of crank 23 and endless chain 19 towards the bottom of the candle in the direction of arrow 34 in a way that the lower edge 35 of the piston-wall 17 removes mechanically said excess through a scraping action. The impurities are pushed by means of wall 16 towards the bottom of the candle while the oil flows through opening 26 of the bottom 16 of

the piston in the opposite direction of the arrow 36. Disk 27 during this motion remains on account of its own weight resting on ring 28. When there is no more oil under the bottom 16 of the piston, but only a body of semisolid impurities, disk 27 is pushed upwards and closes the opening 26, so that the impurities are compelled downwards. In this way and through the opening of the valve 32 the body of impurities is pushed through the pipe 31 in the direction of the arrow 37 out of the apparatus. When piston 16—17—18 arrives at the bottom of the candle, crank 23 is turned in the opposite direction and therewith the piston 16—17—18 goes upwards in the opposite direction of the arrow 34 and therewith opening 26 of the bottom of the piston 16 is free again.

Fig. 4 represents a simpler construction of an apparatus following the same sweating principle and is employed there where small quantities of oil come into consideration. The device according Fig. 4, is composed principally of a container 46 at the bottom of which there is an insulating layer 47, on which an electrical resistance 48 is applied, which is regulated through the thermostat 49; on this resistance is adapted a diaphragm 50 which is made of a perforated metallic surface on which a metallnet 51 is adjusted. Below the perforated plate 50 another metallnet 51 can be placed. The metallnet 51 is covered by the porous wall 52 which is kept on place by the ring 53. A pipe 54 which is funnel-shaped at 55 at its upper end runs through all said parts and terminates below with a siphon 56, the opening 45 of which is placed above the container 41. The pipe 54 is perforated in correspondence to the empty space below diaphragm 50 by several holes 59 which allow the bright oil to run out; electrical heating may be replaced by a water-bath.

The used oil is first fed in the direction of arrow 42 in the container 46 and a certain quantity of the bright oil in the direction of arrow 44 in the funnel 55 of pipe 54 in order to load the siphon. The very light suction of pipe 54 permits a rapid outflow of the bright oil from the space 43. Means 38 for the removal of the exceeding portion of the separated impurities are shown at 38 as pivoted on the tube 54 supported by means of the roller 39 on the border of the container 46 and compelled to turn by means of a handle 40 or the like.

With reference to the construction as shown in the Figures 5 to 13 it is to be observed that the device for the application of the sweating process is composed by a number of elements 66 which are contained in a tank 61 which is insulated by a layer of insulating material 62; the cover 63 in the form of a plate presenting a container 64 has at its bottom a perforated metallic plate or net 65, for the retention of the coarsser impurities when oil is fed in the apparatus; the used oil goes through the net 65 and fills the inside of the tank 61 and comes into contact with the active surfaces of the sweating elements 66.

Each of said elements (Figures 8 and 9) are composed of a rectangular frame 67 made out of C-structural iron which limits two opposite flat surfaces on which are successively adjusted the following pieces: a perforated plate 68, a metal net 69 and a piece of cloth 70 made of asbestos or of some of the other aforesaid materials. Wires 111 lay at the outer surface of cloth 70. These wires are very thin and are made with metal having a high tensile strength. A frame 71 fixes all aforesaid pieces and same is kept on place by the screws 72 which are fastened in the holes 73 on said frame 67. Each frame has at the bottom and in the middle a pipe 75 which ends with a shoulder 76 and a frustro-conical projection 77, both of which are perforated by the canal 78; the frames have in their upper part a handle 74.

A cross-beam 79 (Fig. 6) which is fastened at the opposite walls of the container 61 carries frustro-conical seats 80 the shapes of which correspond to the frustro-conical projections 77, as shown in Fig. 5. A pipe 81 which goes through the walls 61 and 112 of the apparatus is connected with each of said seats 80 and is closed by a cock 82, so that to each sweating element corresponds a cock 82.

Cross-beams 85 (only shown in Figures 5 and 7) are fixed on hinges 84 (which are shown only in Fig. 7); said cross-beams carry the pressure screws 86 (only shown in Figures 5 and 7) which act upon the upper edge of frame 66; 87 represents (Fig. 7) fasteners which are movable around 88 and serve to fasten the cross-beams 85 on their place, or to allow to lift them for taking out or fixing the elements 66; 89 is a device which serves to heat the used oil and 90 is a thermostat which keeps at a determined temperature apparatus 89. The working of the described parts of the apparatus is as follows:

The used oil is fed in the container 64, the coarser impurities are retained on net 65, and the rest of the oil flows downwards, fills tank 61 and comes into contact with the cloth 70 which corresponds to wall 1 shown on Fig. 1 at the outer surface of the cloth or plate 70 is formed a layer which corresponds to layer 3 of Fig. 1. The bright oil enters in the inside of the elements 66, which process is allowed by the presence of the net 69 and of the perforated plate 68 (as happens in the pieces 51 and 50 of Fig. 4). The separated impurities remain attached on the sweating surface 70 and accumulates (as will be shown hereinafter) at the bottom of the tank 61, wherefrom they are removed by opening from time to time the valve 83, the bright oil flows out through the cocks 82; if one of the elements 66 for some reasons or other runs cloudy, it is sufficient to close the corresponding cock 82. On the sweating surface 70 accumulates also a layer of deposit and when the thickness of same is too great, a part of it is removed as indicated hereinafter.

For this purpose the apparatus of Figures 5 to 13 besides the aforesaid metal wires 111, is provided with cross-shafts 91 which are turnable and are pivoted on wall 61, and one of which comes out through packing 93 from the wall 112 and ends with the square head 94. At the ends of the cross-shafts 91 are adjusted the little pulleys 92. A chain is vertically mounted on said pulleys 92; another chain 110 is mounted horizontally below. Said chains are stretched by means of a swivel of known construction and which are not shown. The inward branch of the vertically disposed chains are represented in Fig. 5 with 95 and the outer branch with 96. On each side of an element 66, facing with the exterior surface of a sweating plate 70 a means is provided for the scraping of said exterior surface of the sweating plate 70 and same is working on wires 111. Said scraping means 102 can take either the close position, as shown in Figures 10 and 13, or can

take the spaced position as shown in Figs. 11 and 12.

The Figures 10 and 11 show these scraping means 102 and their supports as if they were separated from the apparatus, but it is necessary to understand that between two scraping means either in close or spaced position an element 66 is always comprised.

Each of said scraping means 102 possesses at both ends a hole through which passes the cross-rod 97 at one end or the cross-rod 98 at the other end; the ends of cross-rods 97 and 98 are provided with projections 99 respectively 100, which are disposed horizontally, same as the edge of the scraping means 102, and carry at their ends means, for instance a little hole 113 respectively 114, by means of which they are attached respectively to said chain-branches 95 and 96. The ends with hole 113 are for instance attached with branches 95 (left on Fig. 5), and the ends with hole 114 are connected with branch 96 (right on Fig. 5). A chain or another suitable mean 110 (Fig. 5) connects the rod 91 at one side of the apparatus with rod 91 at the other side, so that when the square head 94 is turned, the rods 91 on one side turn in the opposite sense to the rods 91 placed at the opposite side and therefore the chain-branch 95 (left on Fig. 5) moves in the same direction as the chain-branch 96 (right on Fig. 5). Therewith the scraping means 102 are moved downwards or upwards uniformly. Springs 101 are provided between the projections 99 and 100 and the ends of the contiguous scraping means 102 and also between the ends of the scraping means 102 placed at sides of each element 66. Said springs serve to press the scraping means 102 towards the sweating surface of the plates 70.

The scraping means 102 end at their outer side with bent portions 103 and between them and the cross rods 97 respectively 98 are placed driving members 104 which may remove the scraping means 102 from the sweating surface of the plates 70; these driving members can take by means of the abutment members 105 and 106 the lowered position shown in Figures 10 and 13 or the raised position shown in Figures 11 and 12 and therewith the scraping means 102 are obliged to assume respectively close position shown in Figures 10 and 13 or spaced position shown in Figures 11 and 12.

The way of working of the device is as follows:

During the working of the apparatus the scraping means 102 lay below in spaced position (Figures 11 and 12) while the driving members 104 with their lower edges, which lay on the abutment members 105, have taken the position shown in Figures 11 and 12.

When an excess of impurities has accumulated on the exterior surfaces of the sweating plates 70 and it is necessary to remove a part of them, in a way so as to allow that only the thin layer, as indicated with 3 in Fig. 1 remains attached to them, the group of the scraping means 102 are moved upwards by means of a rotation of the squarehead 94, while the active edges of the scraping means 102 are at a certain distance from the surface of the sweating plates 70 (i. e. in the position shown in Figures 11 and 12); this rotation is continued so long till the upper edges of the distancing means 104 come into contact with upper abutment members 106, which are put on the vertical path of said means 104. When this happens the distancing means 104 cannot move any further while the cross-rods 97 and 98 and the scraping means 102 can still continue this upward motion till they reach the position as shown in Fig. 13. In this moment through the action of the springs 101 the scraping means 102 take the position shown in Figures 10 and 13 in which the scraping edges come into contact and press the metal wires 111 which lay on the exterior surface of the sweating plate 70. When now the squarehead 94 is made to rotate in the opposite direction, the group of the scraping means 102 runs downwards pressing said wires 111, so that the surface of the sweating plate 70 is practically untouched and cannot then therefore be damaged, while the group of the scraping means 102 is caused to lower in the position shown in Figures 10 and 12. In this way the excess of deposited impurities is removed from the surface of the sweating plate 70 and falls downwards, while on said surface a layer of deposited material remains, which is of a thickness about equal to the diameter of the wires 111; when the distancing means 104 come into contact with the lower abutment member 105, the scraping means 102 go apart from each other and take again the position shown in Figures 11 and 13; if the first scraping should not be sufficient, the operation can be renewed; the scraped impurities are pushed downwards and drop out through valve 83.

In order to avoid that on account of the especially high resistance of the material, out of which the wires 111 are made of, they may with the time carve the active edges of the scraping means 102 while they work in position shown in Figures 10 and 13 (which scraping means 102 are made of a less resistant material), so that the thickness of the layer t (Fig. 1) on the surface of the sweating plate 70 may be reduced, the wires 111 (Figures 5 and 8) are adjusted on the sweating surface with a certain inclination from the perpendicular line, whereas the horizontal lying scraping means 102 are moving strictly perpendicularly and cannot therefore be carved in.

In order to avoid that there might be differences of pressure in the inside of each sweating element 66 on its upper portion by means of, threaded hubs 116 they are provided with an air-vent 115 which goes through the hole 108 of the cover 63 and ends upwards with a head provided with holes 107.

109 is a thermometer which shows the temperature of the oil.

The above modes of construction are given only as examples, but a great many other can be employed in order to apply the fundamental principle of the present invention, as for instance when it is the question of treating materials for which similar conditions of work exist and which have a different nature as used oils.

For instance it is possible to immerse (Fig. 2) the electrical resistances 9 in the interior of the candles 6, each pipe 31 can work independently as shown in Fig. 2, or they may open into a common conveyor, which in its turn will have a sole outlet for the impurities of the complete apparatus.

It is also possible to have several containers 45 (Fig. 4) placed vertically one upon the other, which are then crossed by the same pipe 54. The sweating means could also be built following the mode of construction of the Kelly or Sweetland filter, or similar apparatus.

When the apparatus are of a larger size the

frustro-conical or pyramidal bottom 117 is replaced by a flat bottom which limits below the rectangular shape of the apparatus and is placed immediately underneath the resistance **89**. The impurities assembled on this flat bottom are removed by scraping them longitudinally and have them fall for instance in a channel-shaped rotating discharger with an inferior longitudinal outlet incorporated in the device, or in a pyramidal shaped funnel placed at one side of the bottom wherefrom they can be withdrawn through a valve in the same manner as through valve **83**.

A stream of steam may be blown countercurrently to the dripping oil by having it enter for instance through the sweated oil outlet so as said steam may flow in the inside of each sweating element going from the inferior to the superior part of same and coming out through the air-vents above.

Therewith two purposes are achieved:—firstly the heating of the apparatus, and—secondly the distillation of the fuel which may be contained in the oil.

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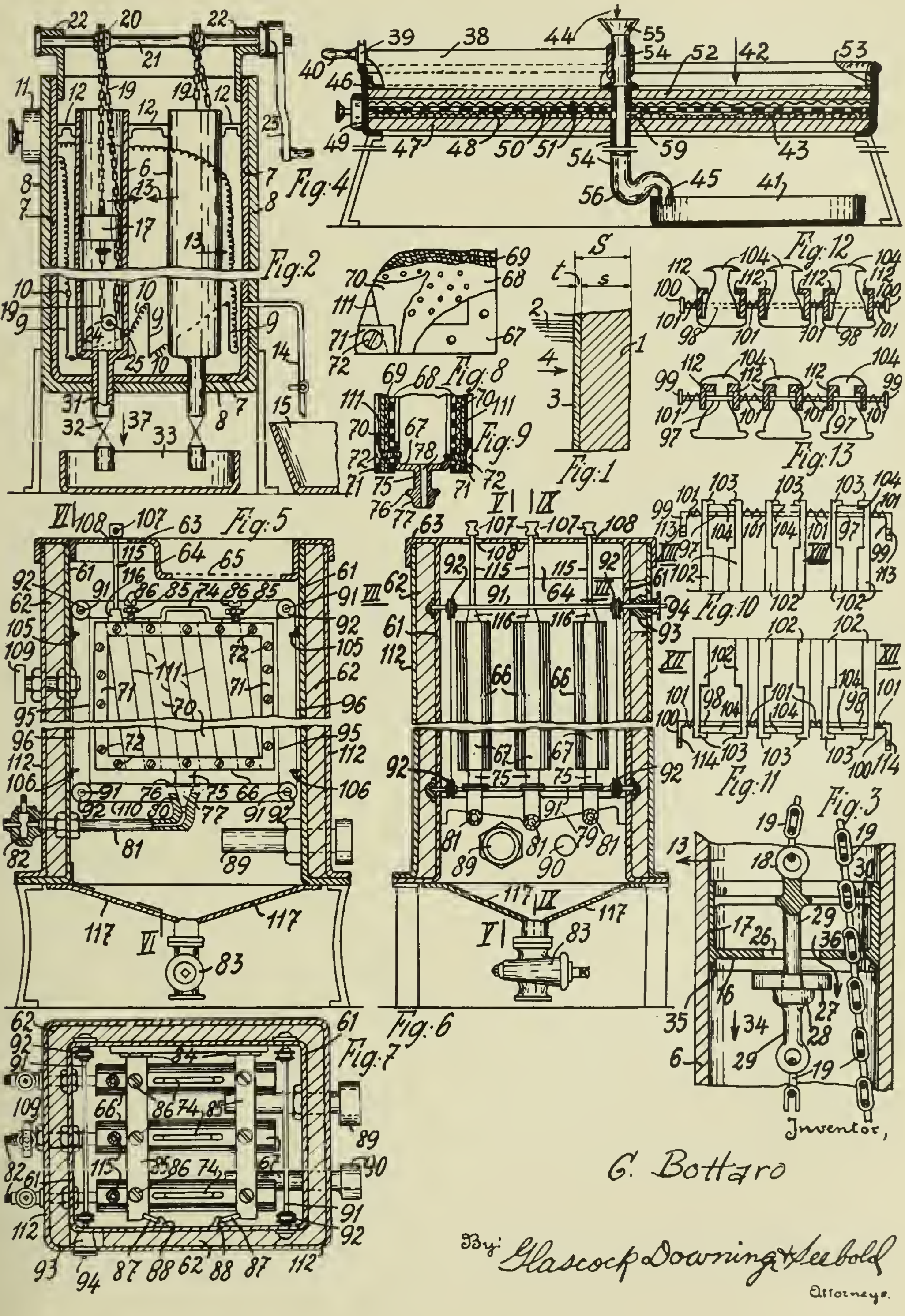

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ALIEN PROPERTY CUSTODIAN

PURIFICATION OF PULP

Hellmuth Banning, Duren/Rhld, Germany; vested in the Alien Property Custodian

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The present invention relates to improvements in the purification of paper-cellulose- or wood pulp in centrifuges.

Centrifuges for the purification of cellulose-, paper- or wood-pulp are known in which the drum or the outer drum of a concentrically mounted plurality of drums is provided with one or more annular parts or rings projecting radially inwards. While the centrifuge is in rotation cellulose fibres separate out from the vertical fluid stream and deposit as a cushion or cushions of fibres against the wall of the drum beneath the ring or rings, and become more compact the longer the centrifuge is in operation. The specifically heavier impurities are thrown against and embedded in this cushion. The specifically lighter impurities, if present, separate during rotation of the centrifuge, collect on the inner vertical surface of the fluid stream and are driven by the rise of the latter to the highest possible point, where they are obstructed by a ring or like obstructing device. This obstruction is known as a damming and skimming ring and forms together with another ring or annular part, an outlet channel for discharging the purified pulp. This channel further has a throttling action on the speed at which the fluid stream climbs within the drum.

In order that the maximum purification effect of the centrifuge shall be obtained, it is desirable that each particle of the fluid stream should remain as long as possible in the centrifuge, thus being submitted for as long as possible to the centrifugal force set up. A low stream velocity for each particle favours the easy deposition of attached impurities. On the other hand it is desirable that the output shall be high, which means that as great a quantity of material as possible should pass through the centrifuge in unit time.

It has now been ascertained that in order to obtain a high speed of output with a low stream velocity, the fluid stream should be as wide radially as possible. The wider the fluid stream is relatively to the thickness of the corresponding compact cushion, the lower is the stream velocity. Thus a doubling of the width of the fluid stream means that a particle thereof remains twice as long in the centrifuge, subjected to the purifying centrifugal force. The speed of feeding the material to be purified to the centrifuge has an influence on the width of the fluid stream, in that with increasing speed of feed the stream width increases. It is also of economic advantage to provide for a decrease in the power consumption of the centrifuge and further it is desirable to reduce to a minimum the whirling of deposited or separated impurities.

It is known that the throttling action of a discharge channel may be increased by decreasing the cross-sectional area. It has been found that the positioning of the inner vertical surface of the fluid stream by damming and throttling may be effected by extending the length of the channel inwards towards the axis. This has the effect of discharging the purified pulp at a position nearer to the axis of the centrifuge, where there is a smaller circumferential velocity so that the power consumption of the centrifuge is reduced.

It is further of importance that the distance between the inner vertical surface of the fluid stream and the axis of the centrifuge be kept constant during the operation of the centrifuge and any horizontal movement of the fluid stream avoided. This constancy is desirable in particular for the correct operation of a skimming pipe or like device to remove the lighter impurities. If it were possible to fix the position of the skimming device so that it remained constant in relation to the surface of the fluid stream throughout the operating period of the centrifuge, unprofitable supervision work could be avoided. Further it would be possible to immerse the skimming pipe horizontallly into the fluid stream to a position where the lighter impurities would be removed without removing any of the purified pulp, thus effecting considerable saving in loss of good material.

Therefore in accordance with the present invention in a centrifuge for the purification of cellulose-, paper- or wood-pulp there are provided for the purified pulp at least two outlets whereby the inlet end of one of the outlets is situated farther from the axis of the centrifuge than the inlet end of the second or other outlet and whereby the one outlet, the outer one, has a substantially damming and throttling action and the second or other, the inner one, acts substantially as a discharging channel, for the purpose of maintaining the distance between the axis of the centrifuge and the inner vertical surface of the fluid stream constant, the conditions being such that there is a minimum of feed, which minimum should be equal to or greater than the output of the outer channel.

In order that the outer channel shall have a throttling action preferably the cross-sectional area thereof should not be greater than that of the inner channel.

In order that these results may be obtained, it

is of importance that discharge outlets for the purified pulp be constructed in a particular manner.

If desired according to the invention a skimming ring is provided for the lighter impurities, part of which is situated horizontally below the outlets in such a manner that the ring obstructs the lighter impurities which may collect during the rotation of the centrifuge on the inner vertical surface of the fluid stream, being forced by the latter to rise upwards. Furthermore according to the invention one or more outlets are formed by socket pipes which extend from the inner vertical surface of the fluid stream and penetrate the wall of the centrifuge. Thereby, according to the invention, means may be provided to move the socket pipes in a horizontal direction in order to adjust its position in respect to the inner vertical surface of the fluid stream. Further, according to the invention a bounding surface is provided which is arranged in such a manner as to be partly or totally common to a subdivided or double outlet, i. e. for two outlets.

Further, according to the invention, a centrifuge is provided for the purification of cellulose-, paper- or wood-pulp characterized in that one discharge outlet for the purified pulp comprises at least two bounding surfaces its inlet end being situated further from the axis of the centrifuge than its outlet end and the bounding surfaces being so shaped that they each possess at least one point of inflection above which the pulp is directed inwards towards the axis of the centrifuge and wherein the outermost bounding surface below the first or only point of inflection rises parallel to the axis of the centrifuge.

According to a further embodiment of the invention there is provided a centrifuge for the purification of cellulose-, paper- or wood-pulp, characterized in that the outer discharge channel is contained between a skimming or damming ring and an annular member attached to and above the, or the uppermost of a plurality of, annular inwardly projecting parts or rings, provided to build up one or more compact cushions of fibres in which the heavier impurities are embedded, said member being of such shape that it first rises substantially parallel with the axis of the centrifuge and then is inclined inwards, the skimming or damming ring being of such shape that it first rises in a direction inclined towards the said outer member and then is inclined inwards, at least the lower part of the discharge channel thus being formed with a conical cross-section which diminishes progressively towards the point where the said member and the skimming or damming ring are inclined inwards.

If desired the inwardly inclined portions above the point of inflection of the outer member and the skimming or damming ring forming the outer discharge channel are made parallel to one another, or incline towards one another providing a channel of conical cross-section.

Centrifuges are known which have one drum or have two or three drums concentrically mounted one within the other and consecutive or parallel feeds. The one drum centrifuge even when operating in conditions which give the maximum purification has an insufficient yield, even if constructed with relatively very large parts. Centrifuges with two or more drums give an increased yield of purified material, but access to the interior walls has hitherto been difficult on account of the construction, so that there has been difficulty in removing the cushions of fibres containing the heavier impurities which are found adhering to the walls at the end of the centrifuging operation, and performing other cleaning operations by hand, scraping or sluicing with water.

If sufficient space is left between the drum walls to render accessibility easy, the centrifuge becomes too wide to operate with mechanical efficiency.

It has already been proposed to feed centrifuges from the bottom, but it is desirable from the point of view of convenient lay-out of the plant that they be fed from the top for the reason that the pulp to be purified can thus reach the centrifuge in uncovered gutters or channels instead of pipes. Thus the inlet has to be arranged on top. Again, the outlet should not be elsewhere in view of the fact that the purified pulp has to flow downwards from the centrifuge to the level of the sieve of the Foudrinier Machine (the stage of manufacture in a papermaking plant which follows the pulp purification stage is generally that of forming the paper sheets on the sieve of the papermaking or Foudrinier Machine) and it would not be desirable from the point of view of space economy to arrange the main body of the centrifuge higher than the sieve level. As both inlet and outlet have to be on top of the centrifuge they must be arranged nearly on the same level each to the other, the centrifuge itself being below the level of the papermaking machine. This arrangement permits of the various machines being placed economically near together and for the pulp stream to flow from one stage to the next by the shortest and most convenient route.

Centrifuges with two drums operating with a low power consumption and yet having drums which are readily accessible for cleaning purposes may be constructed according to this invention which provides a centrifuge for the purification of cellulose-, paper- or wood-pulp wherein two drums mounted one within the other are provided with a consecutive feed, and the wall of one or of each drum is or are provided on the interior with one or more inwardly projecting annular parts or rings for the purpose of promoting the building up of a cushion or cushions of fibres in which the heavier impurities are embedded, and wherein the distance between the two walls against which the cushions build up increase either regularly or irregularly from the bottom upwards, the uppermost point of the cushion covered part of the outer wall being approximately on the same horizontal level as the uppermost point of the inner wall.

According to the present invention there is further provided a centrifuge for the purification of cellulose-, paper- or wood-pulp comprising one or more drums and provided with a consecutive feed, and wherein the material to be purified is introduced so that it impinges on to an accelerating device in the form of a disc or impeller attached at or near the top of the main spindle driving the centrifuge and located beneath a stationary inlet, so that the material is accelerated and thrown off radially in a direction parallel or substantially parallel to that of the centrifugal force, towards the upper part of the drum or inner drum, where more than one drum is provided.

The disc or impeller may be removable and may be provided with radial or scoop-shaped ribs or baffles or the like. Further a spray protect-

ing cover may be provided either attached to the ribs or baffles or to a stationary inlet forming part of the cover of the centrifuge. Further this stationary inlet may be constructed to pivot vertically so that the interior of the centrifuge may be rendered accessible for cleaning.

It is further of importance that the discharge channel or outlet be constructed in such a shape that accumulations of fibres on the walls or the outlet may be easily removed.

The invention will now be described with reference to the following diagrammatic drawings in which:

Figures 1 and 2 show diagrammatically the mechanism of the action of a subdivided or double outlet, i. e. two outlets as applied in the case of the normal type of horizontal outlets.

Figures 3 and 4 show diagrammatically another application of the action of a subdivided or double outlet, i. e. two outlets wherein Figure 3 is a longitudinal cross-section of the centrifuge and Figure 4 a part of the plan view thereof.

Figure 5 shows a section through part of the barrel of a centrifuge in which the discharge channel is provided with a subsidiary subdividing intermediate ring, and the outer portion of the resulting double channel is shaped in accordance with the invention.

Figures 6, 7 and 8 show modifications of the discharge channel shown in Figure 5.

The Figures 9 and 12 illustrate in sectional views and diagrammatically different shapes of centrifuges with double drums provided with a feed accelerating device and discharge channels in accordance with the invention.

Figure 10 shows a sectional view through a two-drum centrifuge wherein a cover is provided attached to the stationary inlet above the feed accelerating disc.

Figure 11 shows a sectional view through a two-drum centrifuge wherein a cover is provided which is attached to baffles on the feed accelerating discs.

Figures 13 and 14 illustrate on a larger scale the discharge channels shown in Figures 9–12.

Figure 15 is a section through a feed accelerating disc as shown in Figures 9 and 12.

Figure 16 is a plan view of the feed accelerating disc shown in Figure 13.

Figure 17 is a plan view of the feed accelerating disc shown in Figure 15 with a different arrangement of baffles.

Figure 18 shows an enlarged sectional view of the feed accelerating disc shown in Figure 10, and

Figure 19 shows an enlarged sectional view of the feed accelerating disc shown in Figure 11.

In all the figures like parts are represented by like reference figures or letters.

a, *b* and *f* represent the distance between the cushions of fibres **1**, **12** and **123** respectively and the axis 0 of the centrifuge. *c* represents the distance between the inner unbroken vertical surface of the fluid stream **2** and the axis of the centrifuge and *d* the distance between the inner circumference of the outermost ring and the axis of the centrifuge. The lighter impurities collect at **6** if present.

The conditions, such as speed of rotation, rate of feed and dimensions of the rings **8** and **9** and the cross-sectional area of the discharge channel are arranged so that *c* is always less than *a* or *b* or *f*. The distance *c* is principally controlled by the distance *d*, and *c* is always less than *d* on account of the throttling action set up by the discharge channel.

Figure 1 shows diagrammatically the mechanism of the action of a subdivided discharging outlet. Between the rings **4** and **5** an intermediate ring **7** is provided. This ring has a damming function. The outer channel between the rings **4** and **7** as well as the inner channel between the rings **7** and **5** both, discharge the pulp, but the outer channel in addition provides for a throttling action, whilst the inner channel has no such effect. Consequently, the distance from the vertical portion of the ring **7** to the axis of the centrifuge, which is indicated by *e*, controls the distance indicated by *c* between the inner vertical surface of the fluid stream **2** and the axis in that *c* becomes equal to *e*. Naturally a condition for this constant distance of the inner vertical surface is that the amount of pulp supplied into the machine should be at least as great as the amount discharged by the outer channel. The rate of discharge of the outer channel between the rings **4** and **7** is reduced to a definite maximum depending on its cross-section and on the cushion forming action of the ring **4**. This cushion forming is limited in principle by the length of the ring **4**, but in practice the immerging depth of the ring **7** controls the thickness of the cushion. If the thickness of the cushion were to increase so that it reached the outer point of the ring **7**, the fibres would be driven out by the liquid and discharged through the channel. As a matter of fact the cushion never reaches the outermost point of the ring **7**.

The reason why a congestion in the channel between **4** and **7** cannot occur viz. the cushion cannot overlap the outermost point of the ring **7**, is due to the pressure of the centrifugal force, which increases with the radius of the centrifuge. As the cross-section of the inlet of the outer channel is smaller than the cross-section of the inlet of the inner channel, the outer channel is not able to discharge the same amount per time unit as the inner channel, notwithstanding the greater centrifugal pressure the outer channel is subjected to. These circumstances provoke a reaction resulting in a throttling or damming effect within and beneath the outer channel whilst the inner channel is free from such influence and any pulp which has reached the innermost point of the ring **7** must discharge, there being therefore no possibility of forming a vertical inner surface closer to the axis. On the other hand, provided the amount of pulp fed into the centrifuge is as great as the amount discharged by the outer channel—no vacillating of the liquid vertical surface in the direction of the wall of the centrifuge is possible, since the throttling or damming effect of the outer channel would balance such a tendency.

Thus an outlet which is subdivided into two parts divides as well the functions of a simple outlet. A simple outlet has a discharging and throttling effect. The double-outlet charges the outer division with a throttling and partly discharging action, whilst the inner division is entirely discharging. The throttling action of the outer channel is used as a valve for the inner channel thus enabling a constant distance between the inner vertical surface of the pulp cylinder and the axis.

Figure 2 again shows the mechanism of a subdivided outlet. Here the ring **7** is located above the ring **4**. In this case the ring **7** has no influence on the thickness of the cushion **1** which is

governed by the width of the ring 4. As the inner vertical surface of the cushion 1 approaches the inner circumference of the ring 4 the velocity of the fluid stream 2 drives the oncoming fibres out of the centrifuge. As has been shown in Figure 1 the throttling action of the outer channel increases with the diminution of its cross-section. On the other hand the velocity of the fluid stream which is discharged through the outer channel increases with the throttling action. Thus—in order to avoid a whirling which could affect embedding of the heavier impurities in the cushion part near the outlet—it is advisable not to exaggerate the throttling effect of the channel contained between the rings 4 and 7 as shown in Figure 4.

Figures 3 and 4 show another embodiment of a subdivided or double outlet for the purified pulp. A flat circular ring 7 is arranged deeper in the centrifuge than a ring or top edge 4 of the drum, so that the outer part of the ring 7 is located below the ring 4. A plurality of short pipes 14 penetrating the outer wall of the drum are provided, their free ends projecting horizontally and radially into the space between the circular flat ring 7 and a skimming ring 5 arranged beneath the latter. In this particular case the inner ends of the pipes 14 are all located at a distance *c* from the axis which distance is smaller than the outer diameter of the skimming ring 5 and greater than the inner diameter of the ring 7.

That part of purified pulp which does not discharge through the slit between the top edge 4 and the annular ring 7 becomes dammed in the drum inwardly towards the axis and enters the pipes 14 and thus discharges outwards. The distance *c* between the axis and the inner vertical surface of the fluid stream thus becomes equal to the distance between the innermost entrance end of the pipes and the axis. The embodiment of the invention according to Figures 3 and 4 provides for a plurality of outlets for the purified pulp whereby the inlet end of one, namely the outlet between the rings 4 and 7 is situated further from the axis than the inlet end of the group of outlets formed by the socket pipes. Obviously in order to provide for a maximum of efficiency it is advisable to locate the innermost inlet ends of all pipes—in the case where a plurality is used—on the same circumferential distance from the axis.

In Figure 5 a drum is shown with a different kind of outlet. Thereby the function of the ring 9 is divided by means of a ring 10 placed intermediate between rings 8 and 9, and performing the damming function, rings 8 and 10 form a throttling and discharging channel and rings 9 and 10 form a discharging channel, the lighter impurities collecting under the ring 9 and being removed by the skimming pipe 11. The distance *e* controls the distance *c*. The channel between the rings 8 and 10 has principally a throttling function.

Further Figure 5 shows the outer portion of a discharge channel constructed in accordance with the invention. The uppermost cushion of fibres 1 is retained by the ring 4 on which an annular part or ring 8 is mounted forming with an annular part or ring 9 a discharge channel. The surface of the ring 8 in contact with the fluid stream is shaped as shown in the figures so that it first rises vertically and is then inclined inwards towards the axis of the centrifuge. The outer face of the ring 9 first rises at an angle inclined to the inner face of the ring 8 and then inclines inwards parallel to the ring 8 from a point at a corresponding height to that of the point of inflection of the ring 8. If desired the upper part of the ring 8 may incline towards the upper part of the ring 9. Thus any point on the ring 8 is always at a greater distance from the axis of the centrifuge than any corresponding point on the ring 9. The lower part of the discharge channel thus is of conical cross-section diminishing in size in the upward direction. The lighter impurities 6 collect beneath the ring 9 as shown in the figures. In this case the distance *d* in connection with the cross-sectional area of the discharge channel controls the distance *c*. The shorter *d* is, the shorter *c* will be. The wall of the drum, may be the outer drum of a plurality of concentric drums, and may have a plurality of cushion-promoting rings.

The throttling action can be increased by increasing the inclination of the rings 8 and 9 towards one another.

Discharge channels having the above-mentioned characteristics provide in particular for a decrease in the speed of the fluid stream. Furthermore the throttling effect taking place principally in the upper part of the channel, i. e., in a position remote from the uppermost part of the cushion in which the heavier impurities collect and remote from the uppermost part of the fluid stream where the lighter impurities, if present, collect. Thus, any whirling of deposited heavy impurities, or of lighter impurities which may have collected, is avoided. Again the discharging purified pulp leaves the centrifuge at a minimum distance radially from the axis, the inclination towards the axis of the upper part of the channel causing a decrease in the circumferential speed and consequently providing for a decrease in the power consumption of the centrifuge.

In Figure 6 is shown another embodiment of the double discharge channel of Figure 5 in which the outer face of the lower part of the ring 10 is inclined towards the inner face of the ring 8. The channel formed thus resembles that shown in Figures 13 and 14. The upper part of the ring 10 may, however, be parallel with or inclined towards either rings 8 or 9.

In Figure 7 the lower part of the intermediate ring 10 below the point of inflection of the ring 10 shown in Figure 6 is missing. Here again the ring 10 need not necessarily be parallel to rings 8 and 9.

In Figure 8 the outer channel is suppressed. A slit 13 is provided in the ring 10 and this slit performs the function of the outer, principally throttling channel formed between the rings 9 and 10 of Figures 5, 6 and 7. Instead of one or more slits, a plurality of perforations may be arranged circumferentially in the ring 10. These slits or perforations may also be provided on the vertical part of the ring 8.

In case that the pulp does not contain lighter impurities or the removal of lighter impurities should not be desirable or worth while the innermost or skimming ring 5 or 9 in Figs. 1 to 8 can be suppressed. By increasing the feed of material to be purified the stock will discharge over the innermost point or points of the now inner ring and the output will exceed normal or calculated one.

The centrifuges shown in Figures 9 to 12 comprise two drums one inside the other attached together and rotating on a common axis.

Referring now to Figure 9, 3 is the wall of the

outer drum and 43 the wall of the inner drum, 161, 4 and 41 are annular parts or rings projecting radially inwards beneath which cushions of fibres containing the heavy impurities deposit against the drum walls. The space between the drum walls increases in accordance with the invention, the point of inflection of the inner drum wall being shown at the ring 161. The inner drum has a wall shaped into two portions of which one has the greater diameter and is provided with rings 16 and 161 for promoting the formation of cushions 15 and 151. The outer drum has a straight wall 3 and is provided with two rings 4 and 41 for promoting the formation of cushions 1 and 12. A discharge opening is formed by rings 8 and 9, the lighter impurities collecting at 6 under the ring 9. In accordance with the invention the lower part of the ring 8 first rises parallel with the axis of the centrifuge and is then inclined inwards. The skimming and damming ring 9 first rises at an angle inclined towards the ring 8 and then is inclined inwards parallel to the upper portion of the ring 8.

Further Figures 9 to 12 illustrate two-drum centrifuges which contain a feed accelerating device. Further details of this feed accelerating device are shown in Figures 15 to 19. The accelerating device comprises a disc 17 mounted on the top of the main shaft of the centrifuge by which it is rotated with the drums. Radial ribs 18 are provided on the disc 17. The pulp to be purified enters the centrifuge and passes through the stationary inlet 19 and impinges on the rotating disc 17 from which it is thrown by centrifugal force against the wall 43 of the inner drum. The lower end of the inlet 19 is provided with a flange 20 to prevent the pulp stream from splashing or spraying over the top of the inner drum. The stream passes down the inner drum building up the cushions 15 and 151, and is then thrown radially outwards into the outer drum where it climbs, forming cushions 1 and 12 and the purified pulp leaves by the discharge channel formed between rings 8 and 9 and falls into the stationary trough 21 and leaves the centrifuge through the outlet 22. The lighter impurities 6 may be removed by a skimming pipe.

In order to clean the centrifuge and remove the cushions which have formed against the walls, the cover of the centrifuge is lifted by the handle 23 and the inlet 19 together with the flange 20 is swung vertically along the line 24 of the hinge 25. The disc 17 thus becomes exposed and can be removed. The walls of the drums are now readily accessible for hand scraping or spray washing, the cleansing operation being performed in shorter time than usual due to the afore-described construction. The shape of the inner drum wall renders access to the outer drum wall easy for the removal of the fibre cushions.

In Figure 10 the inner drum wall 43 remains straight whilst the outer drum wall 3 inclines outwards from the point where a ring 41 is located. The functions of the ring 41 are the same as that of rings 4 and 161.

Figure 10 shows a modified form of the centrifuge shown in Figure 9 wherein the feed accelerating disc is provided with a cover attached to the feed inlet as shown in detail in an enlarged scale in Figure 18. The cover 26 is attached to the end of the feeding inlet 19 by an annular part 27. The cover is situated very close to the top of the baffles or fins 18 on the disc 17 so that only a fine slit separates them. The cover 26 and the inwardly inclined ring 16 retain within the inner drum any spray which may emanate from the impingement on the disc 17. The baffles 18 have a rectangular cross-section to prevent congestion of the formation of lumps of pulp. The inner drum has a straight vertical wall topped by the inwardly inclined ring 16 whereas the wall of the outer drum has two points of inflection 28 and 29 whereby the drum increases in diameter in an upward direction.

Figure 11 shows a further construction of a two-drum centrifuge in which the inner drum wall inclined inwards at the ring 161, and the outer drum wall inclines outwards at the ring 41. The upper part of the skimming ring 9 (Figures 11 and 14) is here shown inclined towards the upper part of the ring 8 so that the upper part of the discharge channel thus formed is conical. The upper part of the ring 9 may also be inclined away from the upper part of the ring 8. Further Figure 11 shows a modification of the construction of centrifuge shown in Figures 9 and 10 illustrating a further possible construction for the feed accelerating disc. The shape of the disc 17 may be seen from the enlarged drawing Figure 19, a cover 30 which is provided with an upturned portion 31 being affixed either to baffles or fins or to supporting members 32 and 33. The disc and cover thus form a detached prolongation of the stationary inlet 19. Congestion and the formation of lumps of pulp is prevented by placing the supports 32 and 33 away from the inlet and towards the circumference of the disc 17, where the maximum centrifugal force reigns. The downward tilt of the disc 17 increases the centrifugal action and promotes the breaking up of pulp accumulations.

Fig. 12 shows a further construction in which both drums have a conical cross-section and discharge progressively from one another.

Figures 15 and 16 show in sectional elevation and in plan a feed accelerating disc 17 provided with baffles or fins 18. The hub 34 is rigidly attached to the top of the shaft of the motor driving the centrifuge.

Figure 17 shows a plan view of a feed accelerating disc 17 provided with scoop-shaped baffles 35.

It will be understood that the invention is not limited to the details of construction and procedure herein illustrated and described, but that departures may be made therefrom within the scope of the invention and without sacrificing its chief advantages.

HELLMUTH BANNING.

PUBLISHED MAY 25, 1943. BY A. P. C.

H. BANNING

PURIFICATION OF PULP

Filed March 7, 1938

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6 Sheets–Sheet 1

Fig. 1

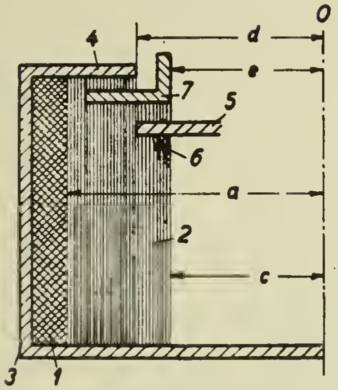

Fig. 2

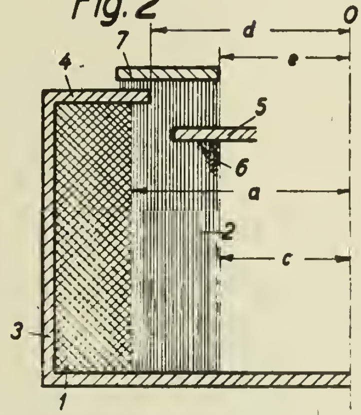

Fig. 3

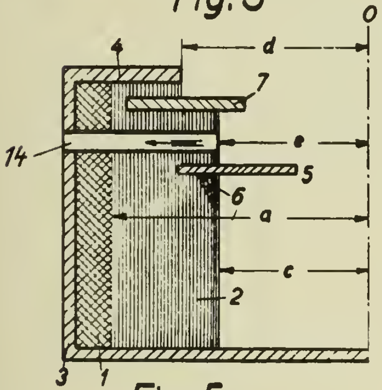

Fig. 4

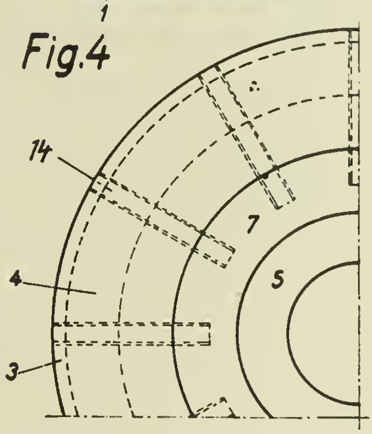

Fig. 5

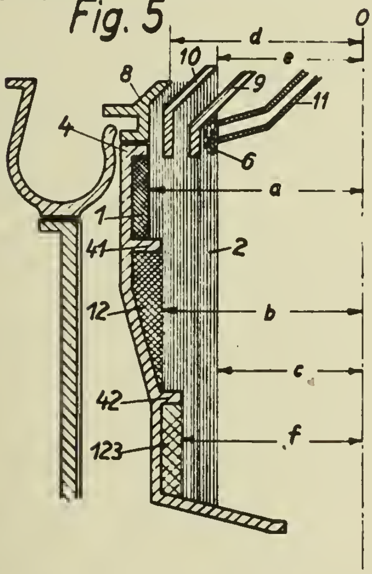

Fig. 6

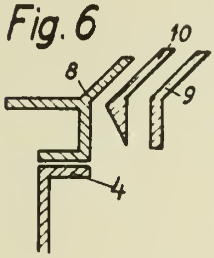

Fig. 7

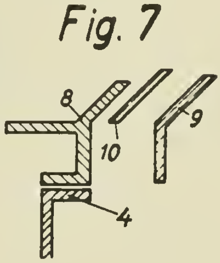

Fig. 8

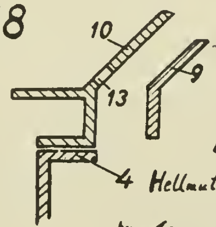

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Fig. 9

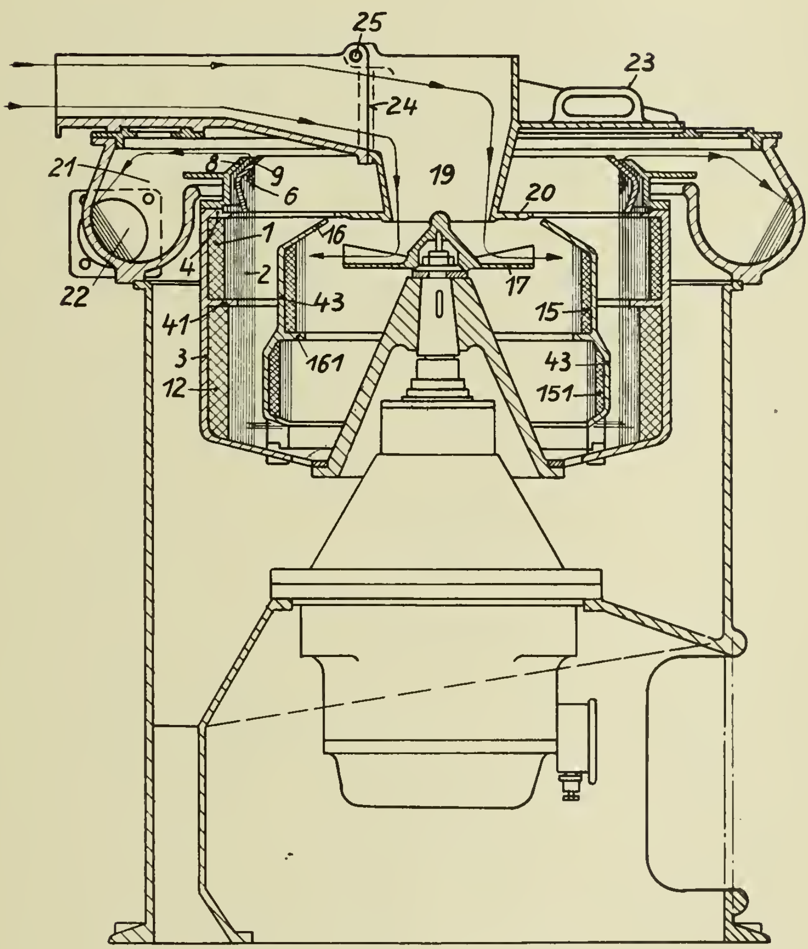

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Fig. 10

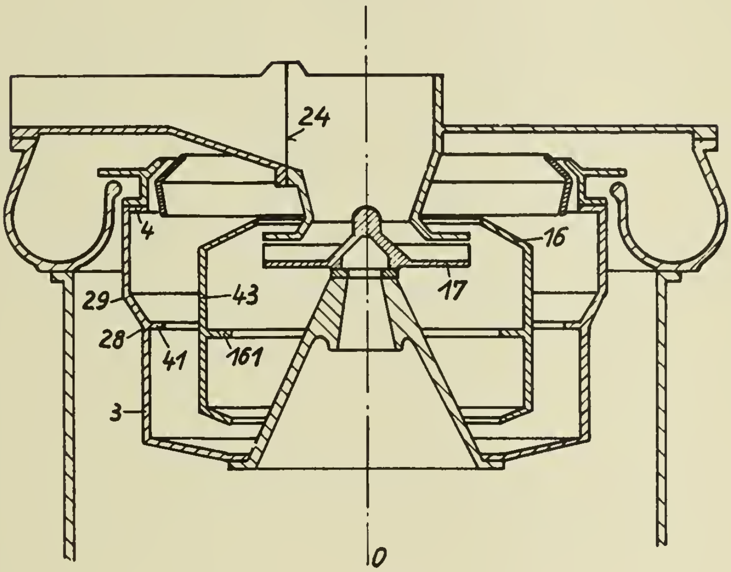

Fig. 11

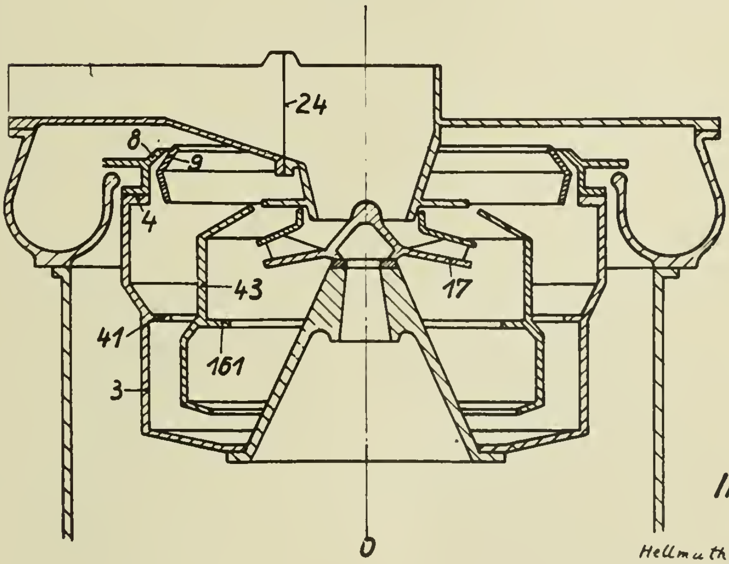

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Fig. 12

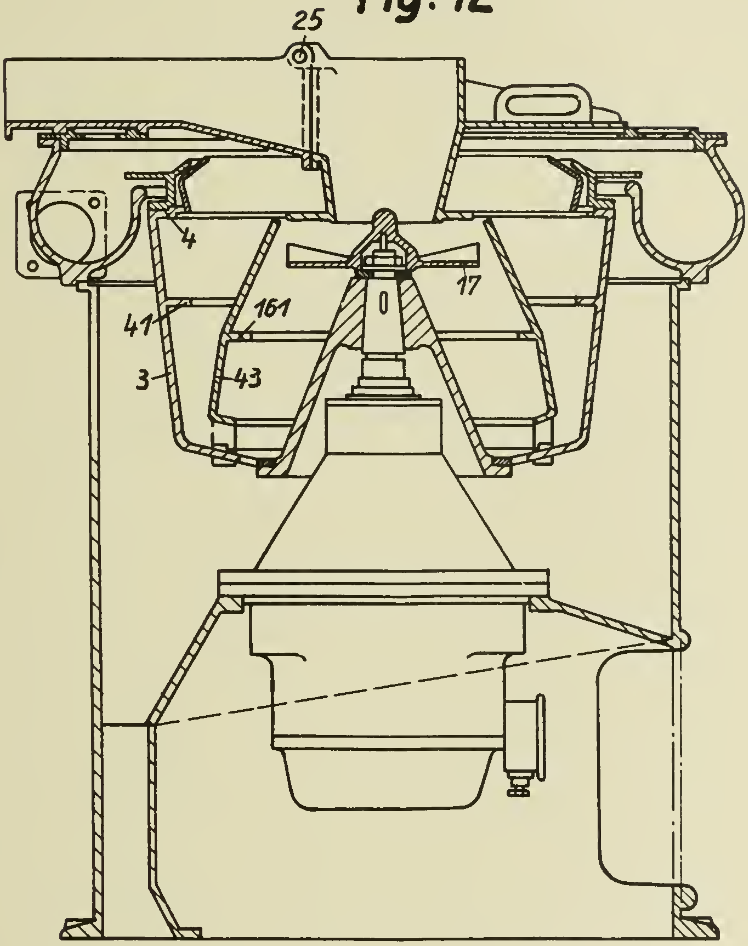

Fig. 13

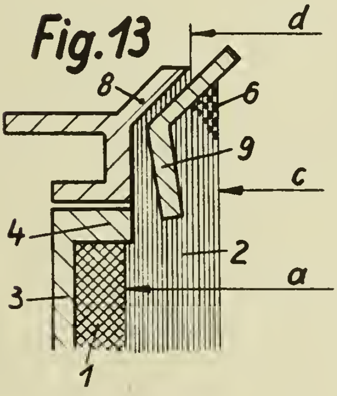

Fig. 14

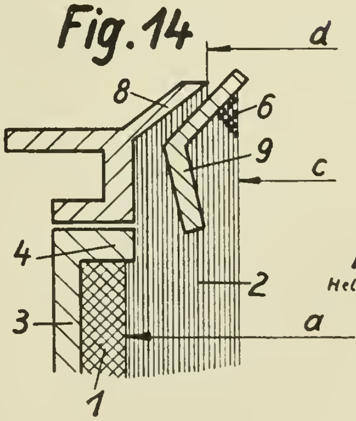

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Fig. 15

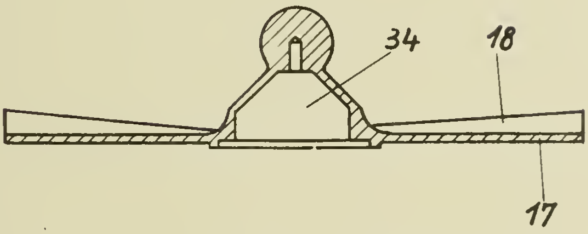

Fig. 16

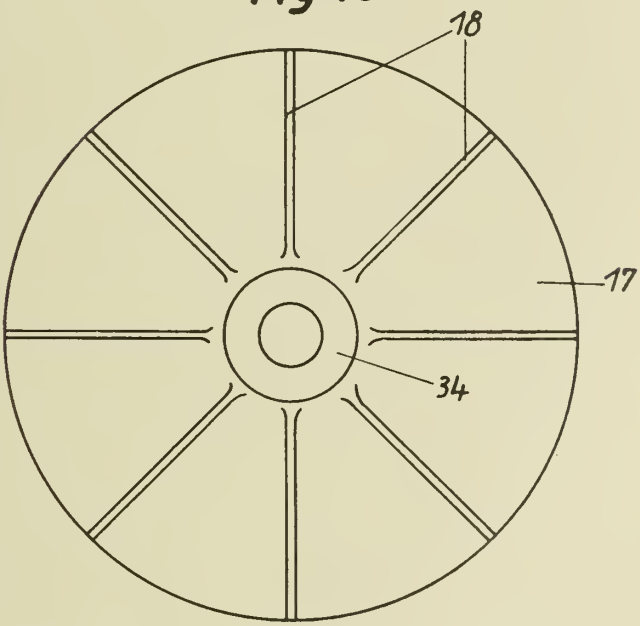

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Fig. 17

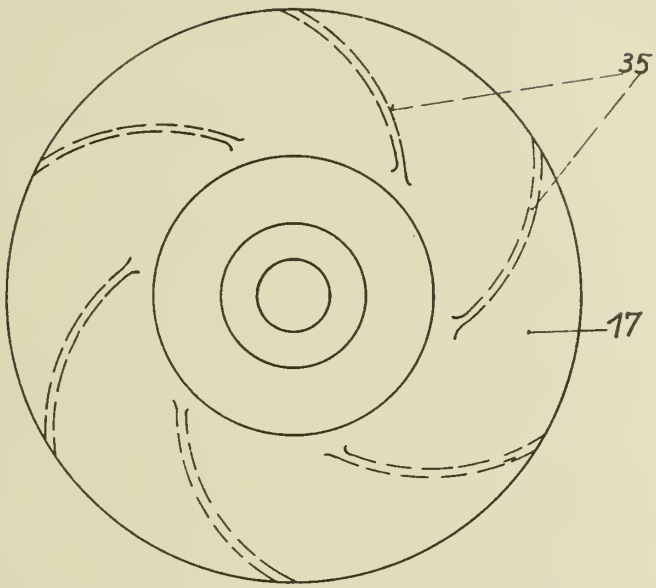


Fig. 18

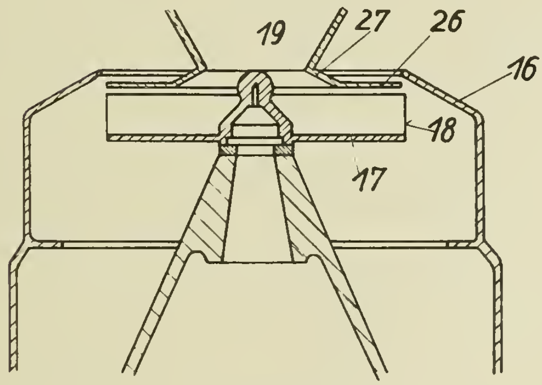
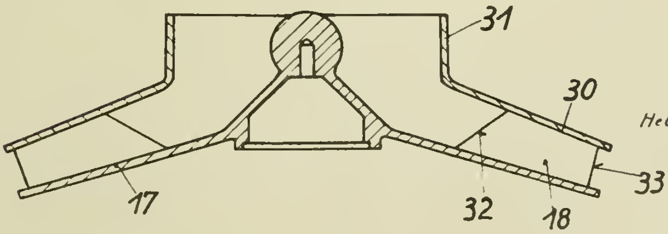


Fig. 19



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Published May 25, 1943

Serial No. 194,754

ALIEN PROPERTY CUSTODIAN

VEHICLE BODIES

Karl Rabe, Stuttgart-N, Germany; vested in the Alien Property Custodian

Application filed March 9, 1938

This invention relates to vehicle bodies and is particularly directed to such bodies formed of artificial resin or the like.

An object of this invention is the formation of an improved vehicle body made of artificial resin.

Another object of this invention is the provision of a vehicle body formed of colored and transparent artificial resin.

A further object of this invention is the provision of a vehicle body in which all of the usual transparent parts are formed of transparent artificial resin.

A still further object of this invention is the provision of vehicle body parts formed of a single integral sheet of artificial resin, part of which is opaque and part of which is transparent.

Other objects will become apparent from the following description taken in connection with the attached drawings showing several illustrative embodiments of the invention and wherein:

Fig. 1 is a side view of a portion of a vehicle body formed according to this invention;

Fig. 2 is a cross-sectional view of the body portion illustrated in Fig. 1;

Fig. 3 is a cross-sectional view of a portion of a vehicle body made in accordance with the principles of this invention;

Fig. 4 is a side view of a portion of a vehicle body illustrating still another manner in which the construction according to this invention may be carried out;

Fig. 5 is a cross-sectional view of the body portion illustrated in Fig. 4;

Fig. 6 is a cross-sectional view illustrating the manner in which portions of the vehicle body may be connected together;

Fig. 7 is a view similar to Fig. 6 illustrating a modified form of construction;

Fig. 8 is a cross-sectional view of half a vehicle body showing the manner in which the vehicle roof may be interconnected with its sides; and

Fig. 9 is a cross-sectional view similar to Fig. 8 illustrating another manner in which the vehicle roof and sides may be interconnected.

Attention is directed to the fact that throughout the drawings colored or opaque artificial resin has been designated by cross-hatching, whereas transparent artificial resin is indicated by the absence of such cross-hatching.

Figs. 1 and 2 illustrate one manner in which my invention may be applied to vehicle bodies. The cross-hatching section A indicates the usual body portion formed in this case of colored or opaque artificial resin. The usual and necessary window in the vehicle is formed by covering the opening C of the body portion A with a plate of transparent artificial resin indicated at B. The plate of transparent artificial resin may be connected in any suitable manner to the main body portion A. In the embodiment illustrated in Figs. 1 and 2, such connection is made on two sides of the window.

Fig. 3 illustrates a manner in which the principles of this invention described with respect to Figs. 1 and 2 may be applied to the roof of a vehicle body. The body portion A extending upwardly as forming the sides of the vehicle is curved inwardly to form a part of the roof. A suitable opening is formed in the roof which is covered by means of transparent artificial resin indicated at B.

Figs. 4 and 5 illustrate another manner in which a plate of transparent artificial resin may be applied to a body of opaque artificial resin to form windows in a vehicle body. The reference character A again indicates the body portion of colored or opaque artificial resin while the reference character B is the plate of transparent artificial resin. The latter is formed in this case with an outer rim D of opaque material which is suitably interconnected with the main body portion A. The plate of transparent material is shown as mounted inside the vehicle body although it is obvious it might be mounted upon the outside.

Fig. 6 illustrates another application of my invention in which the entire roof 1 of the vehicle is formed of transparent artificial resin. This construction is extremely advantageous for vehicles such as sight-seeing buses in which it is desirous that the passengers be able to obtain an unobstructed view both laterally and upwardly while at the same time being protected from the weather. As shown in Fig. 6, the transparent roof portion 1 is suitably curved downwardly at the sides and firmly connected to the sides of the vehicle body indicated at 2 and 3. In order that the outside of the vehicle may present a smooth exterior both for the sake of appearance and for lessening the wind resistance of the vehicle, the body sides are formed with a cut-out portion, as shown, into which the curved ends of the roof are placed, the outer surface of curved ends thereby being flush with the sides of the vehicle.

In Fig. 7 the use of transparent artificial resin is extended to the sides 5 and 6 of the vehicle body, these sides forming together with the transparent roof 4, a complete integral structure.

Fig. 8 illustrates a further form of this invention and shows the manner in which the vehicle windows of transparent artificial resin are positioned in a frame of opaque artificial resin. In this modification the transparent roof 7 is bent downwardly and interconnected with the opaque frame portion 8 in a manner similar to that shown in Fig. 6. The opaque frame member 8 has two cut-out portions, one for receiving the end of the roof member 6 and a second to receive a plate of artificial resin 9 forming the vehicle window. In addition, the further frame member 10 of opaque material is also cut out to receive the lower end of the plate 9. The frame section 10 is integrally interconnected with the further frame portion 11 to form the sides of the vehicle. It will again be noted that in this form of the invention the exterior surface of the vehicle body is formed without any protruding parts, thus presenting a surface which is both neat in appearance and one which offers a minimum of wind resistance.

The construction illustrated in Fig. 9 is similar to that shown in Fig. 8; in this form however, all of the parts being made of transparent artificial resin. The parts 12, 13, 14, 15, and 16 correspond with the parts 7, 8, 9, 10, and 11 of Fig. 8. While not apparent from the view shown in Fig. 9, the joint between the transparent roof 12 and the transparent body side 13 may be filled with some neutral mass of material in order to preserve the smooth outer surface.

From a study of the above the advantages of this invention will be readily apparent. In vehicle bodies up to now the windows have been covered either with dangerous shatterable glass or expensive special or compound glass. In order to mount glass in vehicle bodies special fastenings such as rubber, leather, felt, or other resilient materials must be used. By the use of this invention, the glass plates may be entirely replaced by plates of transparent artificial resin. As this material is extremely strong and comparatively unbreakable, the dangers of shatterable glass or the expense of special glass is eliminated. In addition, no special mounting means or methods need be used.

Another advantage of this construction, as is shown in the forms illustrated, is that a completely smooth outer surface of the vehicle body is obtainable.

Although it has not been illustrated, it is obvious that my invention is adapted to further uses in vehicle bodies. For example, it is entirely within the scope of this invention to form a curved windshield of transparent artificial resin which may be made integrally with or firmly connected to the remainder of the vehicle body. In addition, the front roof supports or columns may be made of transparent material, thereby increasing the field of vision of the driver and eliminating the so-called "blind spots."

A further advantage of my construction is that since artificial resin plates can be colored in almost any desired color, special painting of the vehicles is eliminated. If any impurities occur on the outer surface of the vehicle they can be readily corrected by merely polishing. In case a portion of the vehicle body is seriously injured or broken, all that is necessary is to insert a new plate of artificial resin, thereby accomplishing repairs in a very short time as contrasted with similar repairs to bodies formed of wood or metal.

It will be understood that the principles of this invention can be advantageously used for all types of vehicle construction such, for example, as passenger cars, racing cars, rail, air, and water vehicles. It can also be used for the covering of motorcycles and the formation of bodies for horse-drawn vehicles.

KARL RABE.

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K. RABE
VEHICLE BODIES
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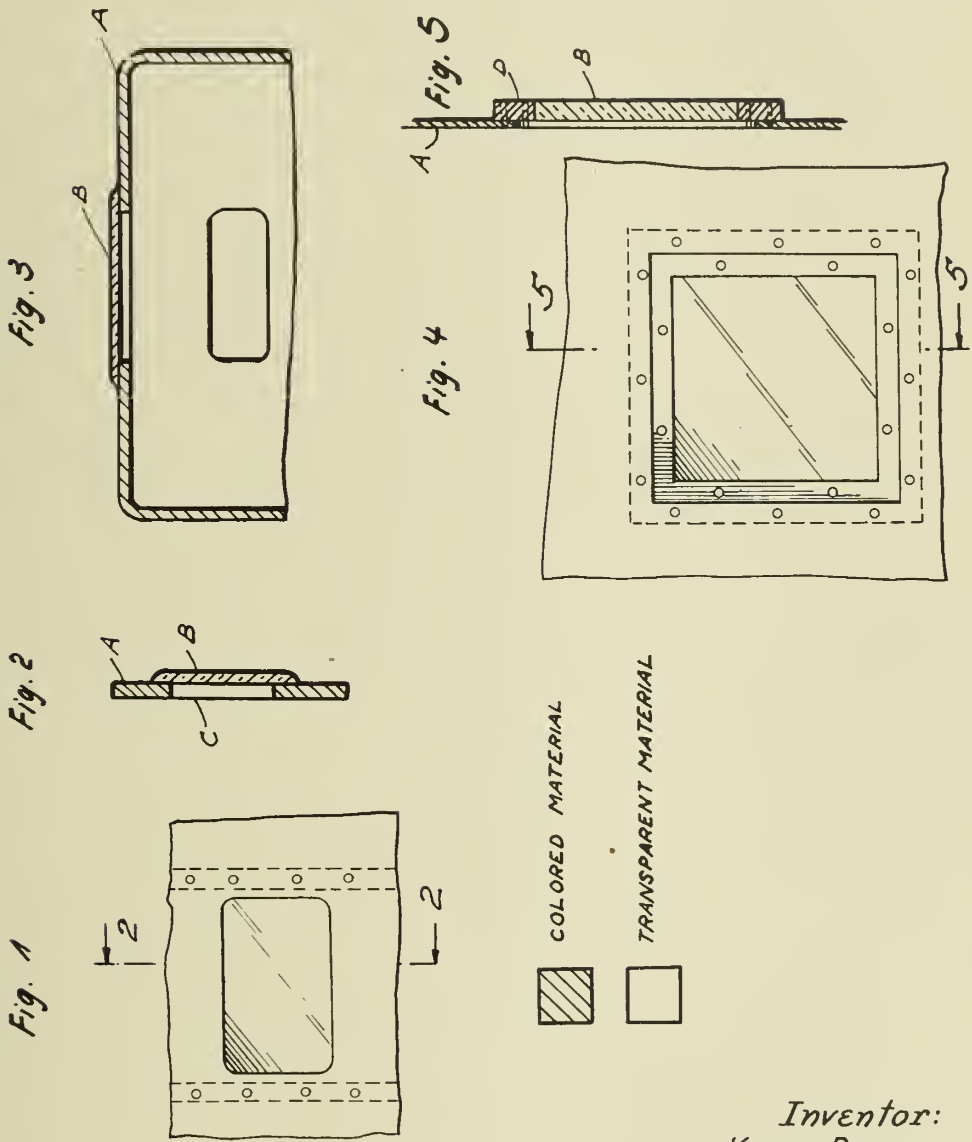

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MAY 25, 1943.	VEHICLE BODIES	**194,754**
BY A. P. C.	Filed March 9, 1938	2 Sheets-Sheet 2

Fig. 6

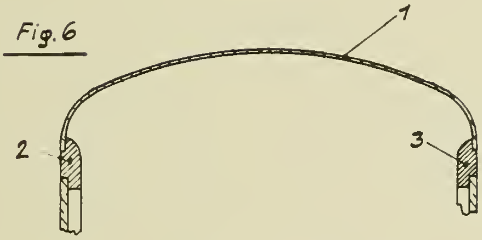


Fig. 7

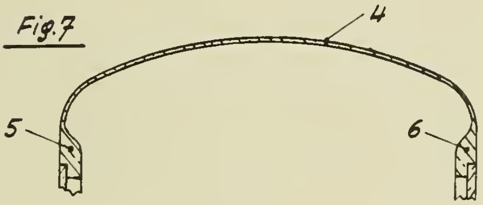


Fig. 8

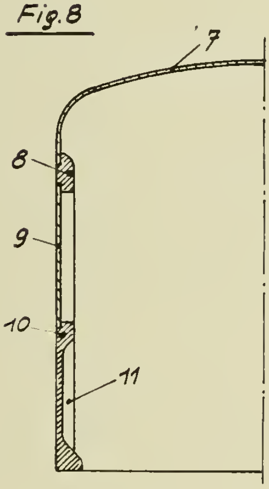
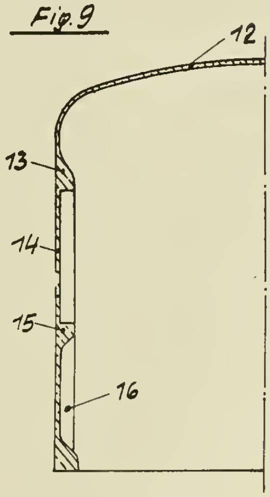


Fig. 9



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ALIEN PROPERTY CUSTODIAN

REGULATING DEVICES FOR SUPERCHARGERS OF INTERNAL COMBUSTION ENGINES

Albert Stieglitz, Berlin-Spandau, Germany; vested in the Alien Property Custodian

Application filed May 4, 1938

This invention relates to regulating devices for superchargers of internal combustion engines, the supercharger being driven by the engine through a gearing having at least two steps.

A supercharger for an internal combustion engine assists the output of the engine by compressing the combustion air or the mixture of air and fuel. In the case of aircraft the supercharger is furthermore intended to maintain the output at high altitudes. The regulation is then effected by influencing the charging pressure by means of a throttle valve which controls the suction side of the supercharger. The speed transmission for the drive of the supercharger is so chosen that the desired maximum output is attained at the desired altitude. Consequently, at lower altitudes and on the ground the suction inlet of the supercharger must be throttled down in order that the maximum permissible charging pressure shall not be exceeded. This is naturally uneconomical and disadvantageous since it is accompanied by losses and increased fuel consumption. Furthermore, the charging air is heated by the partial idle running of the supercharger, and the danger of knocking is thereby increased.

These difficulties can be considerably reduced by subdividing the transmission ratio of the supercharger drive by means of a change-over gear. The maximum throttling is thereby reduced and two or more speed ranges are provided for the supercharger.

With a view to ensuring ready and correct actuation of the gearing, with consequent complete utilization, there is provided, according to the invention, an automatic operation which effects the change-over of the gear ratio at the correct instant and in accordance with working conditions. The changing over of the ratio is initiated at the end of a fixed range of regulation of the internal combustion engine by stops connected to the regulating system. Since, as the following investigation shows, the change-over is mainly dependent upon the position of the throttle determining the charging pressure, the change-over preferably takes place by means of the system for controlling the throttle.

The change-over point for producing a higher speed of the supercharger is always definitely determined by the completely open position of the throttle valve. On the other hand, the change-over from a high supercharger speed to a lower speed must take place at a definite partially closed throttle position.

If H_1 represents the adiabatic level of delivery of the supercharger in the first step, H_2 that of the supercharger in the second step, and H_v the adiabatic level of loss of the partially closed throttle, then the following equation applies for the change-over point:

$$H_1 = H_2 - H_v$$

The outputs of the supercharger are then proportional to the square of the speed, the level of loss of the throttle is proportional to the square of the velocity of the air in front of the throttle, and thus approximately also to the square of the speed. If α is the ratio of the transmission of the two steps or stages, then:

$$Cn^2 = C\alpha^2 n^2 - C_v n^2$$

or

$$C_v = C(\alpha^2 - 1)$$

C_v, and therefore the position of the throttle, are consequently independent of the speed.

Two arrangements, each according to the invention, are shown diagrammatically and by way of example in the accompanying drawings.

In the arrangement shown in Fig. 1 the throttle valve is manually adjustable by means of a rack and pinion **12**, **13** acting on the valve **2** of a control servomotor, and the regulator for the supercharger pressure is operated directly from this control system. A vacuum device or capsule **1** is arranged in a space subjected to the supercharging pressure, axial variations in length of the capsule **1** acting upon the control valve **2**. The piston valve **2** regulates the supply of oil under pressure to the cylinder of a servo piston **3** connected by a link **4** to the throttle valve **5** in such a manner that movement of the working piston **3** causes the valve **5** to turn about its pivot. A rod **6** connected to the link **4** co-operates with a dead centre toggle switch **7**, **8** in such a manner that at the end of the regulating range the switch **7**, **8** changes over and thus the alteration of the step or speed ratio is effected as hereinafter described. The rod **6** has an elongated slot corresponding in length to the range or regulation and engaged by a stud carried by the lever **7**. The toggle switch **7**, **8** is connected to a piston valve **9** of a second servomotor whose piston **10** changes over the two-step gearing by means of the piston rod **11**. The gearing can, for example, be changed over by applying or releasing a brake.

In Fig. 1 the gearing is in the first step. If the throttle valve **5** is now further opened, the lever **7** is turned clockwise as viewed in the drawing until it passes a dead centre position, whereupon the spring snaps the lever **7** into another position, as shown in Fig. 2, on the opposite of

the dead centre to that shown in Fig. 1. From this position, however, the lever 8 as also the piston 9 are shifted to the right by the action of the said spring, and the servo piston 10 is set in movement. In Fig. 2, therefore, the toggle mechanism as also the second servomotor are in the positions for the second step or gear ratio.

It will be appreciated that, if desired, the toggle switch 7, 8, may act directly on the change speed gearing.

Fig. 3 shows an embodiment in which the throttle valve 5 is actuated directly by hand by means of the rod 14 and the two links 15. The links 15 are supported by means of a rod 16 and a bell-crank lever 17 connected to the piston rod 11 of the servo piston 10. In this arrangement the piston 10 moves only in the event of a change-over of the gearing. With this embodiment also, on the movement of the throttle valve 5 into the fully open position, the toggle switch 7, 8 and the piston valve 9 are changed over so that the piston 10 is set in movement. On movement of the piston 10, however, the throttle valve 5 is again moved toward its closed position by the piston rod 11 acting through the lever 17, link 16 and lever 15 so that the charging pressure remains approximately the same as before the change-over. The change-over from high speed to a lower speed takes place in the same way at a partially closed position of the throttle valve 5. On the changing over taking place, the throttle valve 5 is again almost completely opened by the piston 10 acting through the system 11, 17, 16, 15.

ALBERT STIEGLITZ.

PUBLISHED

MAY 25, 1943.

BY A. P. C.

A. STIEGLITZ
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OF INTERNAL COMBUSTION ENGINES
Filed May 4, 1938

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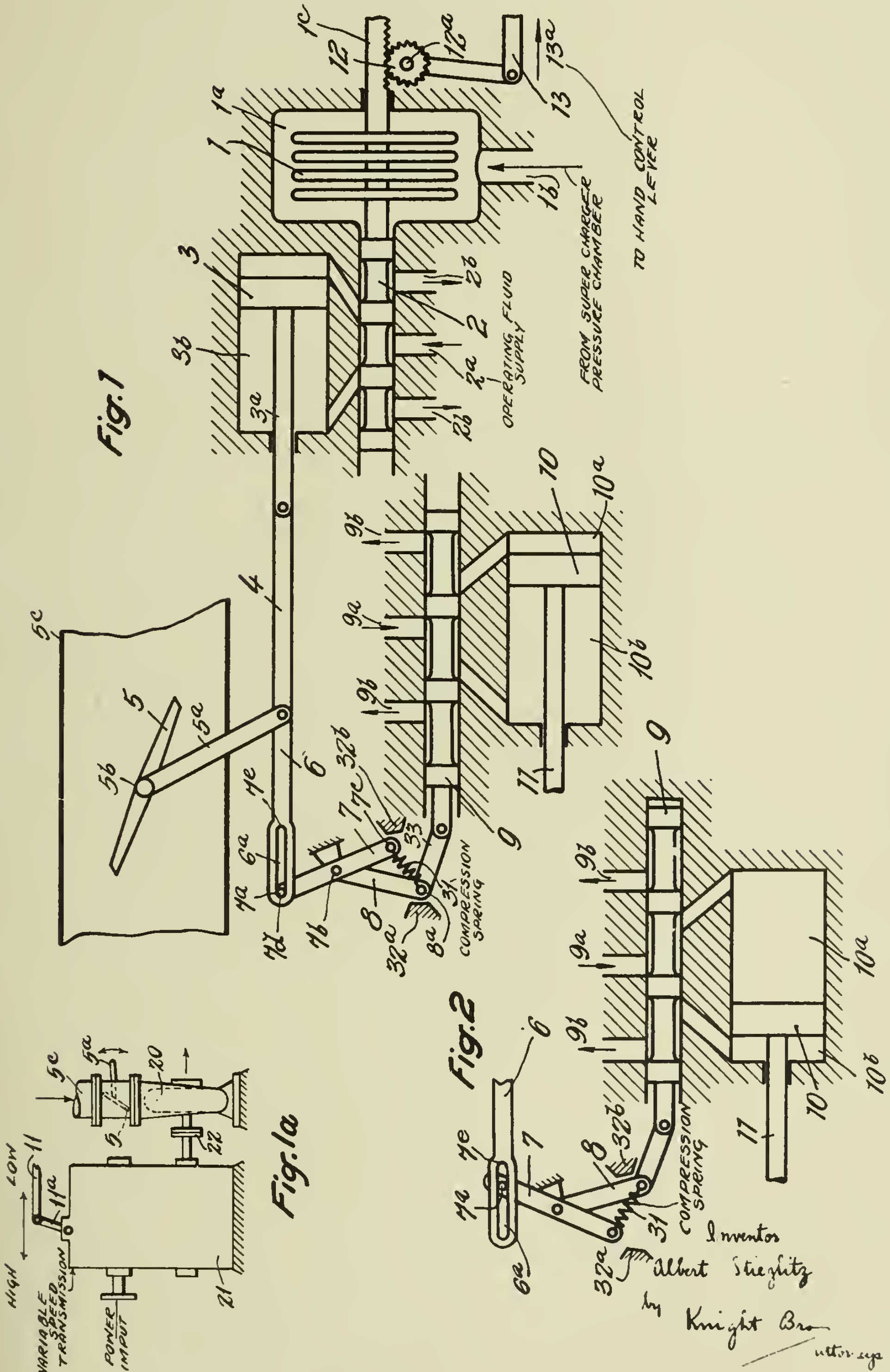

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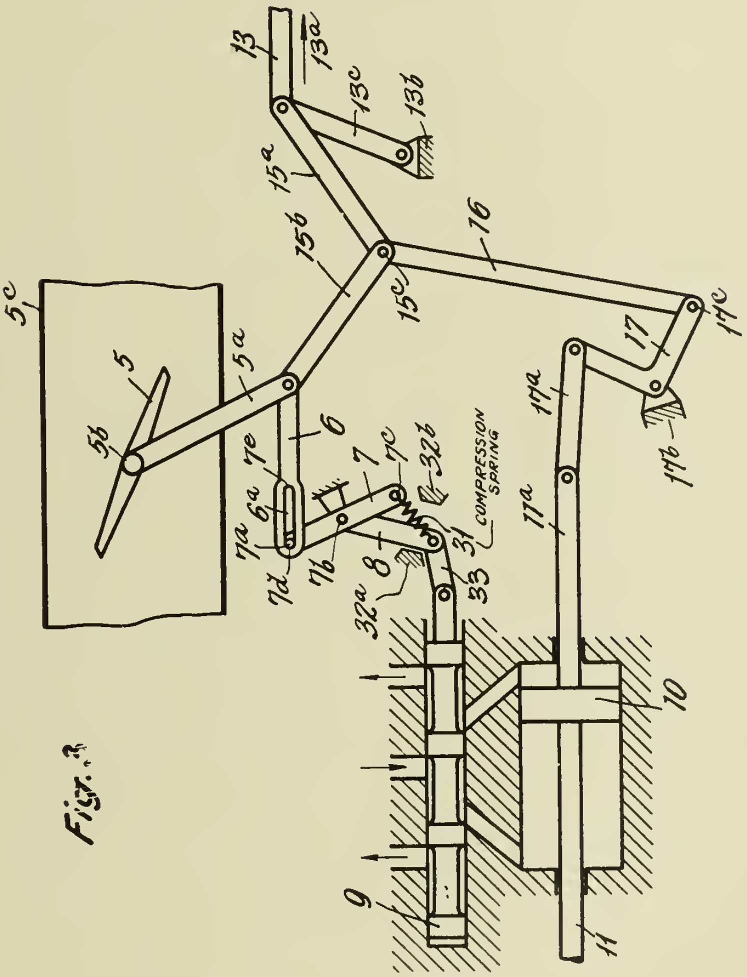

Fig. 3

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ALIEN PROPERTY CUSTODIAN

APPARATUS FOR DETERMINING THE MAGNITUDES REQUIRED FOR PARALLAX CORRECTION

Karl Papello, Jena, Germany; vested in the Alien Property Custodian

Application filed June 7, 1938

The invention refers to an apparatus in which the parallax correction required for laying an antiaircraft gun positioned at a certain distance therefrom is determined by means of the range E of the aircraft from the apparatus, the horizontal distance s of the gun from the apparatus, the lateral angle α between the lines of sight from the apparatus to the aircraft and to the gun, and the elevational angle β of the line of sight from the apparatus to the aircraft.

The invention aims at considerably simplifying the construction of such apparatus by providing three cam systems each of which comprises a plurality of cams arranged in series and effecting two different motions, for instance a rotation and a displacement, and so constructed and connected to each other and to driving mechanisms feeding the known magnitures E, s, α and β that the rearmost cams of the three systems furnish respectively the difference, $\Delta\alpha$, of the lateral angles included between a definite reference line and the lines of sight from the apparatus and the gun to the aircraft, the difference $\Delta\beta$ of the elevational angles of the lines of sight from the apparatus to the gun and to the aircraft, and the difference ΔE of the ranges of the aircraft from the apparatus and the gun, the said magnitudes $\Delta\alpha$, $\Delta\beta$ and ΔE corresponding to the equations

$$\text{(I)}\qquad \Delta\alpha=\arcsin\frac{s.\sin\alpha}{(E\pm\Delta E).\cos(\beta\pm\Delta\beta)}$$

$$\text{(II)}\qquad \Delta\beta=\arcsin\frac{s.\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\sin\beta}{E\pm\Delta E}$$

and

$$\text{(III)}\qquad \Delta E=s.\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\cdot\cos\left(\beta\pm\frac{\Delta\beta}{2}\right)$$

respectively, or to approximate equations derived from these equations by substituting the sine of $\Delta\alpha$ and $\Delta\beta$ for the angle itself and, eventually, by neglecting the magnitudes ΔE and $\Delta\beta$ in equation I, the magnitudes ΔE and $\Delta\alpha/2$ in equation II and the magnitudes $\Delta\alpha/2$ and $\Delta\beta/2$ in equation III.

In the accompanying drawings, Figures 1 and 2 show schematically how the equations determining the sought magnitudes $\Delta\alpha$, $\Delta\beta$ and ΔE are deduced, and Figures 3 and 4 illustrate in schematic plan views two constructional examples of an apparatus according to the invention.

In Figure 1, A is the apparatus, B the gun, and H the aircraft. For the sake of simplicity, A and B are assumed to lie in a horizontal plane. C is the projection of H in this plane. D is an auxiliary point lying in this plane and so positioned that $CD=AB=s$ and $\angle ACD=\angle CAB=\alpha$. F is the point at which a perpendicular dropped from D intersects AC, and G is a point lying in AC and whose distance AG from A is equal to AD. The angle CAD is equal to the angle ACB and illustrative of the difference $\Delta\alpha$ of the lateral angles included between a definite reference line and the lines of sight from the apparatus A and the gun B to the aircraft H. The angle FDG is half the angle CAD and therefore equal to $\Delta\alpha/2$. J is a point vertically above G and lying in a horizontal plane containing H, K is the point at which AH is intersected by a perpendicular dropped from J, and L is a point which lies in AH and whose distance AL from A is equal to AJ. $AJ=AL$ is equal to the range E_0 of the aircraft H from the gun B, and $AH=E$ is the range of the aircraft H from the apparatus A, so that LH is the difference ΔE of the said ranges E and E_0. The angle CAH, viz. the elevational angle of the line of sight from the apparatus A to the aircraft H, is designated β. β is also the magnitude of the angle JHA. The angle GAJ is equal to the elevational angle β_0 of the line of sight from the gun B to the aircraft H. The angle $HAJ=\Delta\beta$ determines the difference between these elevational angles β and β_0. The angle KJL is half the angle HAJ and, accordingly, $\Delta\beta/2$.

It follows at once from Figures 1 and 2, due regard being had to the necessary generalizations, that

$$\sin\Delta\alpha=\frac{DF}{AD}=\frac{s\sin\alpha}{E_0\cos\beta_0}=\frac{s.\sin\alpha}{(E\pm\Delta E\cos(\beta\pm\Delta\beta)}$$

$$\text{(I)}\qquad \Delta\alpha=\arcsin\frac{s\sin\alpha}{(E\pm\Delta E)\cos(\beta\pm\Delta\beta)}$$

$$\sin\Delta\beta=\frac{JK}{E_0}=\frac{JH\sin\beta}{E_0}$$

$$JH=CG=CF-FG$$

$$CF=s\cos\alpha$$

$$FG=s\sin\alpha\ \mathrm{tg}\ \frac{\Delta\alpha}{2}$$

and that, accordingly,

$$JH=s\left(\cos\alpha\mp\sin\alpha\ \mathrm{tg}\ \frac{\Delta\alpha}{2}\right)$$

Assuming in the case of small angles that cos

$$\frac{\Delta\alpha}{2}\sim1$$

and

$$\mathrm{tg}\ \frac{\Delta\alpha}{2}\sim\sin\frac{\Delta\alpha}{2}$$

there is obtained

$$JH=s\left(\cos\alpha\cos\frac{\Delta\alpha}{2}\mp\sin\alpha\sin\frac{\Delta\alpha}{2}\right)s=\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)$$

and, accordingly,

$$\sin\Delta\beta=\frac{s}{E_0}\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\sin\beta$$

or

$$\text{(II)}\qquad \Delta\beta=\arcsin\frac{s\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\sin\beta}{E\pm\Delta E}$$

$$\Delta E=HL=HK-KL$$

$$HK=JH\cos\beta=s\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\cdot\cos\beta$$

$$KL=JK\operatorname{tg}\frac{\Delta\beta}{2}=JH\sin\beta\operatorname{tg}\frac{\Delta\beta}{2}=$$

$$s\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\sin\beta\operatorname{tg}\frac{\Delta\beta}{2}$$

$$\Delta E=s\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\left(\cos\beta\mp\sin\beta\operatorname{tg}\frac{\Delta\beta}{2}\right)$$

Assuming in the case of small angles that $\cos\frac{\Delta\beta}{2}\sim 1$

and

$$\operatorname{tg}\frac{\Delta\beta}{2}\sim\sin\frac{\Delta\beta}{2}$$

there is obtained

$$\Delta E=s\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\left(\cos\beta.\cos\frac{\Delta\beta}{2}\pm\sin\beta\sin\frac{\Delta\beta}{2}\right)$$

$$\text{(III)}\qquad \Delta E=s\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\cos\left(\beta\pm\frac{\Delta\beta}{2}\right)$$

According to the invention, the new apparatus is to furnish the magnitudes $\Delta\alpha$, $\Delta\beta$ and ΔE indicated by the equations I to III, respectively. If slightly reduced accuracies of the magnitudes $\Delta\alpha$ and $\Delta\beta$ are disregarded for the sake of a more simple construction of the apparatus, the calculation of $\Delta\alpha$ and $\Delta\beta$ can be based on the equations

$$\text{(I}a\text{)}\qquad \Delta\alpha=\frac{s\sin\alpha}{(E\pm\Delta E)\cos(\beta\pm\Delta\beta)}$$

$$\text{(II}a\text{)}\qquad \Delta\beta=\frac{s.\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\sin\beta}{E\pm\Delta E}$$

which differ from the equations I and II only in that the sine of $\Delta\alpha$ and $\Delta\beta$ are considered to be equal to the magnitude of the angle itself, as is admissible when small angles are concerned. If the demands made upon the apparatus are reduced even further, the determination of $\Delta\alpha$, $\Delta\beta$ and ΔE can be based on the equations

$$\text{(I}b\text{)}\qquad \Delta\alpha=\frac{s\sin\alpha}{E\cos\beta}$$

$$\text{(II}b\text{)}\qquad \Delta\beta=\frac{s\cos\alpha\sin\beta}{E}$$

$$\text{(III}b\text{)}\qquad \Delta E=s\cos\alpha\cos\beta$$

These equations follow from the equations I*a*, II*a* and III by neglection of ΔE and $\Delta\beta$ in I*a*, ΔE and $\Delta\alpha$ in II*a*, and $\Delta\alpha$ and $\Delta\beta$ in III.

The apparatus illustrated by Figure 3 is used for the determination of the magnitudes $\Delta\alpha$, $\Delta\beta$ and ΔE according to the equations I*a*, II*a* and III. On a plate **1** are rotatably mounted three shafts **2**, **3** and **4**, which are assumed to be continuously rotated by other parts (not represented in the drawing) of the gunnery calculator according to the angle α, the angle β and the range E, respectively. By means of a hand wheel **5** and a threaded spindle **6**, a slide **7** can be adjusted according to the horizontal distance s of the gun from the apparatus. The corresponding indicating device is designated **8**, **9**. The shaft **3**, actuated according to β, rotates by means of a pair of spur gear wheels **10**, **11** and a shaft **12** the crown wheel **13** of a differential wheel gear **14** whose planet wheels **15** are rotated by a shaft **16** (operated according to $\alpha\beta$, as explained hereinafter) and a pair of spur gear wheels **17**, **18** about the axis of the shaft **12** according to $\Delta\beta/2$ so that the other crown wheel **19** of the differential wheel gear **14** and the shaft **20** fast therewith are rotated according to $\beta_0=\beta\pm\Delta\beta$. The shaft **4** actuated according to E operates by means of a pair of spur gear wheels **21**, **22** the planet wheels **23** of a differential wheel gear **24** according to E/2. The one crown wheel **25** of this gear **24** is rotated by a shaft **26** (operated according to ΔE, as explained hereinafter) and a pair of bevel gear wheels **27** according to ΔE, so that the other crown wheel **28** of the differential wheel gear **24** and the shaft **29** fast therewith are rotated according to $E_0=E\pm\Delta E$.

For finding $\Delta\alpha$ use is made of a cam system comprising three cams **30**, **31** and **32**. The cam **30** is displaceable along a grooved shaft **33** rotatable according to E_0 by means of the shaft **29** and a pair of bevel gear wheels **34**. The slide **7** engages by means of a fork **35** the nave **36** of the cam **30** in such a manner that this cam participates in the displacements of the slide **7**. The cam **30**, which is thus displaced according to s and rotated according to E_0, is so constructed that a hollow feeler **37** displaceable along a grooved shaft **38** and continuously kept in contact with the cam **30** by means of a spring **39** is adjusted according to s/E_0. The shaft **38** is rotated by the shaft **2** and a pair of bevel gear wheels **40** according to α. The cam **31** is fast with the feeler **37** and therefore displaced according to s/E_0 and rotated according to α. This cam **31** is so constructed that a hollow feeler **41** displaceable along a shaft **42** and continuously kept in contact with the cam **31** by means of a spring **43** is adjusted according to

$$\frac{s}{E_0}\sin\alpha$$

The shaft **42** is coupled by means of a pair of bevel gear wheels **44** to the shaft **20** and, therefore, rotated according to β_0. The cam **32**, which is fast with the feeler **41** and therefore displaced according to $s/E_0\sin\alpha$ and rotated according to β_0, is so constructed that a feeler **45** mounted on the plate **1** for displacement at right angles to the shaft **42** and continuously kept in contact with the cam **32** by means of a spring **46** is adjusted according to

$$\frac{s}{E_0}\cdot\frac{\sin\alpha}{\cos\beta_0}$$

viz. according to the sought magnitude $\Delta\alpha$. The feeler **45** is fast with a rack **47** in mesh with a toothed wheel **48**. By means of two pairs of bevel gear wheels **49** and **50**, the rotations of the toothed wheel **48** are transmitted to a shaft **51**,

which is therefore rotated according to $\Delta\alpha$. From this shaft **51** the said magnitude $\Delta\alpha$ can be transmitted to other mechanisms of the firing director which are not shown in the drawing.

The shaft **38** rotated according to α carries the one crown wheel **52** of a differential wheel gear **53**, whose planet wheels **54** are coupled to the shaft **51** by means of two pairs of bevel gear wheels **55** and **56** in such a manner as to be rotated about the axis of the shaft **38** according to $\Delta\alpha/4$, so that the other crown wheel **57** of the differential wheel gear **53** and the grooved shaft **58** carrying this crown wheel **57** are rotated according to

$$\alpha \pm \frac{\Delta\alpha}{2}$$

For finding $\Delta\beta$, use is made of a cam system comprising three cams **59**, **60** and **61**. The cam **59** is displaceable along the grooved shaft **58**. By means of a pair of bevel gear wheels **62** a threaded spindle **63** parallel to the shaft **58** is coupled to the threaded spindle **6** in such a manner that a slide **64** displaced by the spindle **63** is adjusted according to s. The slide **64** engages by means of a fork **65** the nave **66** of the cam **59** in such a manner that this cam **59** participates in the displacements of the slide **64**. The cam **59**, which is thus displaced according to s and rotated according to

$$\alpha \pm \frac{\Delta\alpha}{2}$$

is so constructed that a feeler **67** mounted on the plate **1** for displacement at right angles to the shaft **58** and continuously kept in contact with the cam **59** by means of a spring **68** is adjusted according to

$$s \cos\left(\alpha \pm \frac{\Delta\alpha}{2}\right)$$

The cam **60** is displaceable along a grooved shaft **69** which is parallel to the feeler **67** and rotated by the shaft **12** and a pair of bevel gear wheels **70** according to β. By means of a fork **71**, the feeler **67** engages the nave **72** of the cam **60** in such a manner that this cam **60** participates in the adjustments of the feeler **67**. The cam **60**, which is thus displaced according to

$$s \cos\left(\alpha \pm \frac{\Delta\alpha}{2}\right)$$

and rotated according to β is so constructed that a hollow feeler **73** displaceable along a grooved shaft **74** and continuously kept in contact with the cam **60** by means of a spring **75** is adjusted according to

$$s \cos\left(\alpha \pm \frac{\Delta\alpha}{2}\right) \sin \beta$$

By means of a pair of bevel gear wheels **76**, a shaft **77**, a pair of bevel gear wheels **78**, a shaft **79** and a pair of bevel gear wheels **80**, the shaft **74** is coupled to the shaft **29** in such a manner as to be rotated, as is the shaft **29**, according to E_0. The cam **61**, which is fast with the feeler **73** and therefore displaced according to

$$s \cos\left(\alpha \pm \frac{\Delta\alpha}{2}\right) \sin \beta$$

and rotated according to E_0, is so constructed that a feeler **81** mounted on the plate **1** for displacement at right angles to the shaft **74** and continuously kept in contact with the cam **61** by means of a spring **82** is displaced according to

$$\frac{s}{E_0} \cos\left(\alpha \pm \frac{\Delta\alpha}{2}\right) \sin \beta$$

viz. according to the sought magnitude $\Delta\beta$. The feeler **81** is fast with a rack **83** in mesh with a toothed wheel **84**. By means of a pair of bevel gear wheels **85** the rotations of the toothed wheel **84** are transmitted to the shaft **16**, so that, as assumed above, this shaft **16** is rotated according to $\Delta\beta$. From the shaft **16**, the magnitude $\Delta\beta$ can be transmitted to other mechanisms of the firing director which are not represented in the drawing.

The shaft **12** rotated according to β carries the one crown wheel **86** of a differential wheel gear **87** whose planet wheels **88** are coupled by means of a pair of spur gear wheels **89** to the shaft **16** in such a manner as to rotate about the axis of the shaft **12** according to

$$\frac{\Delta\beta}{4}$$

so that the other crown wheel **90** of the differential wheel gear **87** is rotated according to

$$\beta \pm \frac{\Delta\beta}{2}$$

By means of a pair of bevel wheels **91** a grooved shaft **92** is coupled to the crown wheel **90** in such a manner as to rotate likewise according to

$$\beta \pm \frac{\Delta\beta}{2}$$

Along the shaft **92** is displaceable a cam **93** constituting together with the cam **59** the third cam system, which serves for finding ΔE. The feeler **67** engages by means of a fork **95** the nave **94** of this cam **93** in such a manner that this cam **93** participates in the displacements of the feeler **67**. The cam **93**, which is thus displaced according to

$$s \cos\left(\alpha \pm \frac{\Delta\alpha}{2}\right)$$

and rotated according to

$$\beta \pm \frac{\Delta\beta}{2}$$

is so constructed that a feeler **96** mounted on the plate **1** for displacement at right angles to the shaft **92** and continuously kept in contact with the cam **93** by means of a spring **97** is adjusted according to

$$s \cos\left(\alpha \pm \frac{\Delta\alpha}{2}\right) \cos\left(\beta \pm \frac{\Delta\beta}{2}\right)$$

viz. according to the sought magnitude ΔE. The feeler **96** is fast with a rack **98** in mesh with a toothed wheel **99**. By means of a pair of bevel gear wheels **100** the rotations of the toothed wheel **99** are transmitted to the shaft **26**, so that, as assumed above, this shaft **26** is rotated according to ΔE. From the shaft **26**, the magnitude ΔE can be transmitted to other mechanisms of the firing director which are not represented in the drawing.

The described apparatus works automatically as soon as the slide **7** is adjusted by means of the hand wheel **5** according to s and the shafts **2**, **3** and **4** are rotated according to α, β and E, respectively.

An apparatus for maintaining the Equations I, II and III would differ from the described constructional example only by a different construction of the cams **32** and **61**. The cam **32** would

have to be so constructed as to adjust the feeler **45** according to

$$\Delta\alpha=\arcsin\frac{s\sin\alpha}{E_0\cos\beta_0}$$

when displaced according to

$$\frac{s\sin\alpha}{E_0}$$

and rotated according to β_0 and the cam **61** would have to be given a form permitting it to adjust the feeler **81** accordingly to

$$\Delta\beta=\arcsin\frac{s\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\sin\beta}{E_0}$$

when displaced according to

$$s\cos\left(\alpha\pm\frac{\Delta\alpha}{2}\right)\sin\beta$$

and rotated according to E_0.

The apparatus illustrated by Figure 4 serves for finding the magnitudes $\Delta\alpha$, $\Delta\beta$ and $\Delta\Xi$ according to the Equations I*b*, II*b* and III*b*. On account of the smaller demands made upon the accuracy of the found magnitudes, this apparatus is more simple than that shown by Figure 3, the main difference being that it lacks any differential wheel gears. In the following description, the designations are as far as possible the same as in Figure 3.

The mechanisms for calculating $\Delta\alpha$ differ from those of the apparatus shown by Figure 3 only in so far as the grooved shaft **33** is coupled by means of a pair of bevel gear wheels **34** direct to the shaft **4** operated according to E and is therefore rotated according to E (and not according to E_0), and in that the hollow feeler **37** is displaceable along the grooved shaft **2** rotated according to α, and in that the shaft **42** is coupled by means of the pair of bevel gear wheels **44** direct to the shaft **3** operated according to β and is therefore rotated according to β (and not according to β_0). The feeler **45** is consequently displaced according to

$$\Delta\alpha=\frac{s}{E}\cdot\frac{\sin\alpha}{\cos\beta}$$

(and not according to

$$\left.\frac{s}{E_0}\cdot\frac{\sin\alpha}{\cos\beta_0}\right)$$

The transformation of this displacement into a rotation is effected by means of a follower mechanism. This mechanism has a contact piece **101** fast with the feeler **45** and constituting together with two contact members **102** and **103** an electric contact device. The two contact members **102** and **103** are connected to a slide **104** which is displaceable in the one or in the other direction by means of a threaded spindle **105**, a pair of spur gear wheels **106** and a motor **107** when the contact piece **101** touches the contact member **102** or **103**. From the spindle **105**, the magnitude $\Delta\alpha$ can be transmitted to other mechanisms of the firing director which are not represented in the drawing.

The cam system for finding $\Delta\beta$ comprises two cams **108** and **109**. The cam **108**, which is rigidly connected to the cam **31** and therefore likewise displaceable according to E/s and rotatable according to α, is so constructed that a hollow feeler **110** displaceable along a grooved shaft **111** and continuously kept in contact with the cam **108** by means of a spring **112** is adjusted according to

$$\frac{s}{E}\cdot\cos\alpha$$

The shaft **111** is coupled by means of a pair of bevel gear wheels **113** to the shaft **3** in such a manner as to be rotated according to β. The cam **109**, which is fast with the feeler **110** and therefore displaced according to

$$\frac{s}{E}\cos\alpha$$

and rotated according to β, is so constructed that a feeler **114** mounted on the plate **1** for displacement at right angles to the shaft **111** and continuously kept in contact with the cam **109** by means of a spring **115** is displaced according to

$$\frac{s}{E}\cos\alpha\sin\beta$$

viz. according to the sought magnitude $\Delta\beta$. The transformation of this displacement into a rotation is effected by means of a follower mechanism comprising a contact piece **116** which is fast with the feeler **114** and constitutes together with two contact members **117** and **118** an electric contact device. The two contact members **117** and **118** are connected to a slide **119** which is displaceable in the one or in the other direction by means of a threaded spindle **120** and a pair of spur gear wheels **121** and a motor **122** when the contact piece **116** touches the contact member **117** or **118**. From the spindle **120**, the magnitude $\Delta\beta$ can be transmitted to other mechanisms of the firing director which are not represented in the drawing.

Of the two mechanisms **59** and **93** for finding ΔE, **59** is displaceably mounted on the grooved shaft **2** rotated according to α. This mechanism **59** is therefore not only displaced according to s but also rotated according to α. The cam **59** is so constructed that a hollow feeler **123** displaceable along a grooved shaft **124** and continuously kept in contact with the cam **59** by means of a spring **125** is adjusted according to $s\cos\alpha$. The shaft **124** is so coupled by means of a pair of bevel gear wheels **126** to the shaft **3** as to rotate according to β. The cam **93**, which is fast with the feeler **123** and therefore displaceable according to $s\cos\alpha$ and rotatable according to β, is so constructed that a pin **127** mounted on the plate **1** for displacement at right angles to the shaft **124** and kept in continuous contact with the cam **93** by means of a spring **128** is displaced according to $s\cos\alpha\cos\beta$, viz. according to the sought magnitude ΔE. The transformation of this displacement into a rotation is effected by means of a follower mechanism. This mechanism has a contact piece **129** fast with the pin **127** and constituting together with two contact members **130** and **131** an electric contact device. The two contact members **130** and **131** are connected to a slide **132** which is displaced in the one or in the other direction by means of a threaded spindle **133**, a pair of spur gear wheels **134** and a motor **135** when the contact piece **129** touches the contact member **130** or **131**. From the spindle **133** the magnitude ΔE can be transmitted to other mechanisms of the firing director which are not represented in the drawing.

In deducing the equations for $\Delta\alpha$, $\Delta\beta$ and ΔE, it has been assumed for the sake of simplicity that the apparatus A and the gun B lie in a horizontal plane. Taking into consideration any difference in the heights of A and B does not present any difficulties either in the deduction of the corresponding equations or in the construction of a corresponding apparatus.

KARL PAPELLO.

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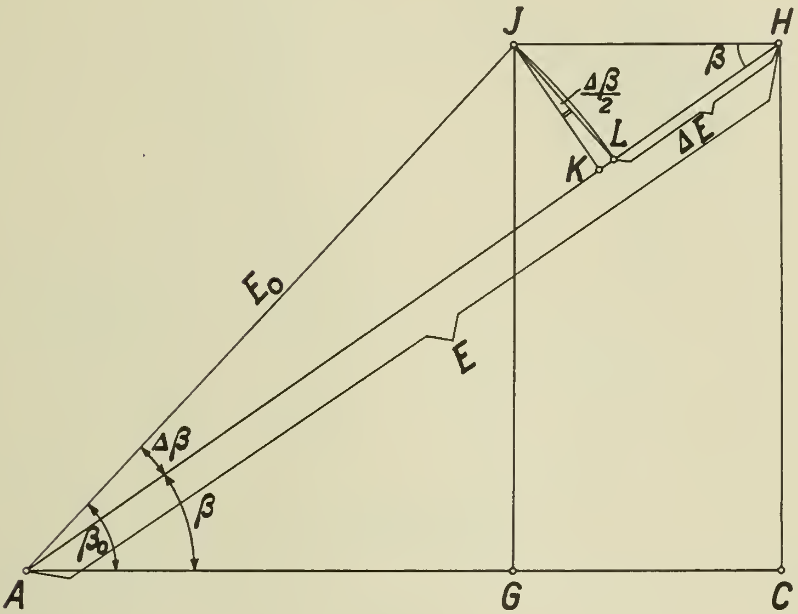

Fig. 2

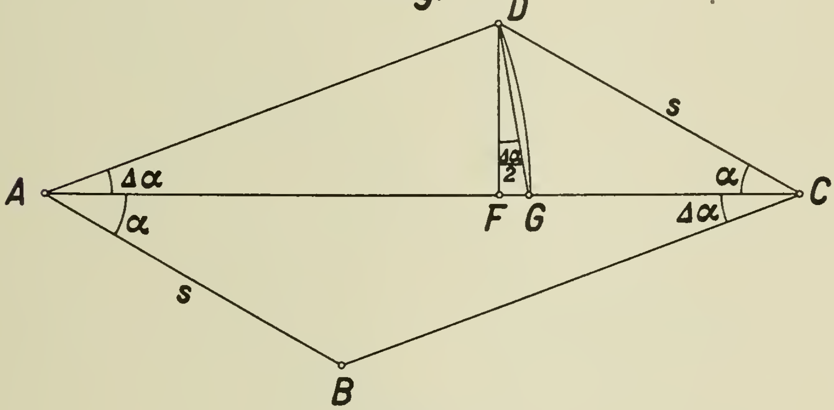

Fig. 1

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3 Sheets-Sheet 2

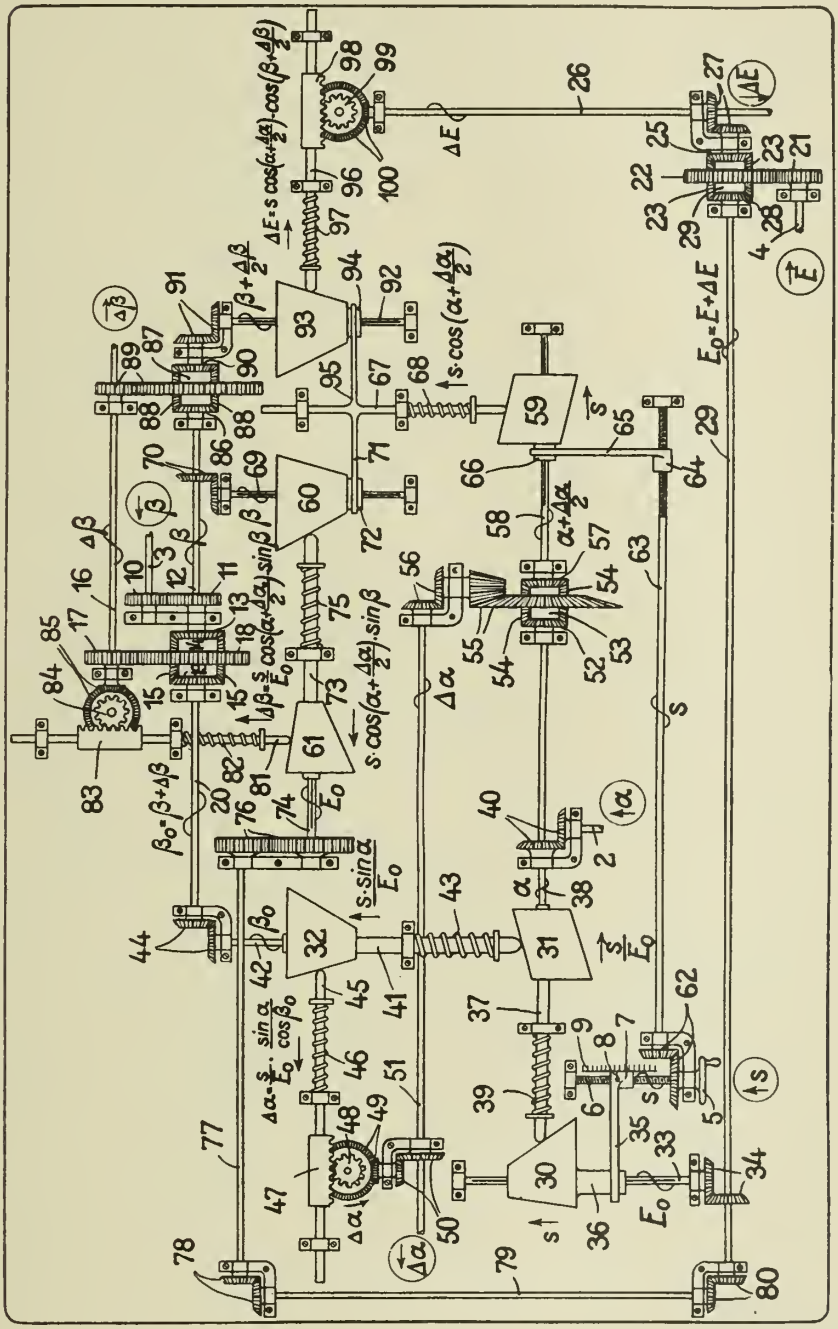

Fig. 3

Inventor:

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MAY 25, 1943.

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APPARATUS FOR DETERMINING THE MAGNITUDES
REQUIRED FOR PARALLAX CORRECTION
Filed June 7, 1938

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212,349

3 Sheets–Sheet 3

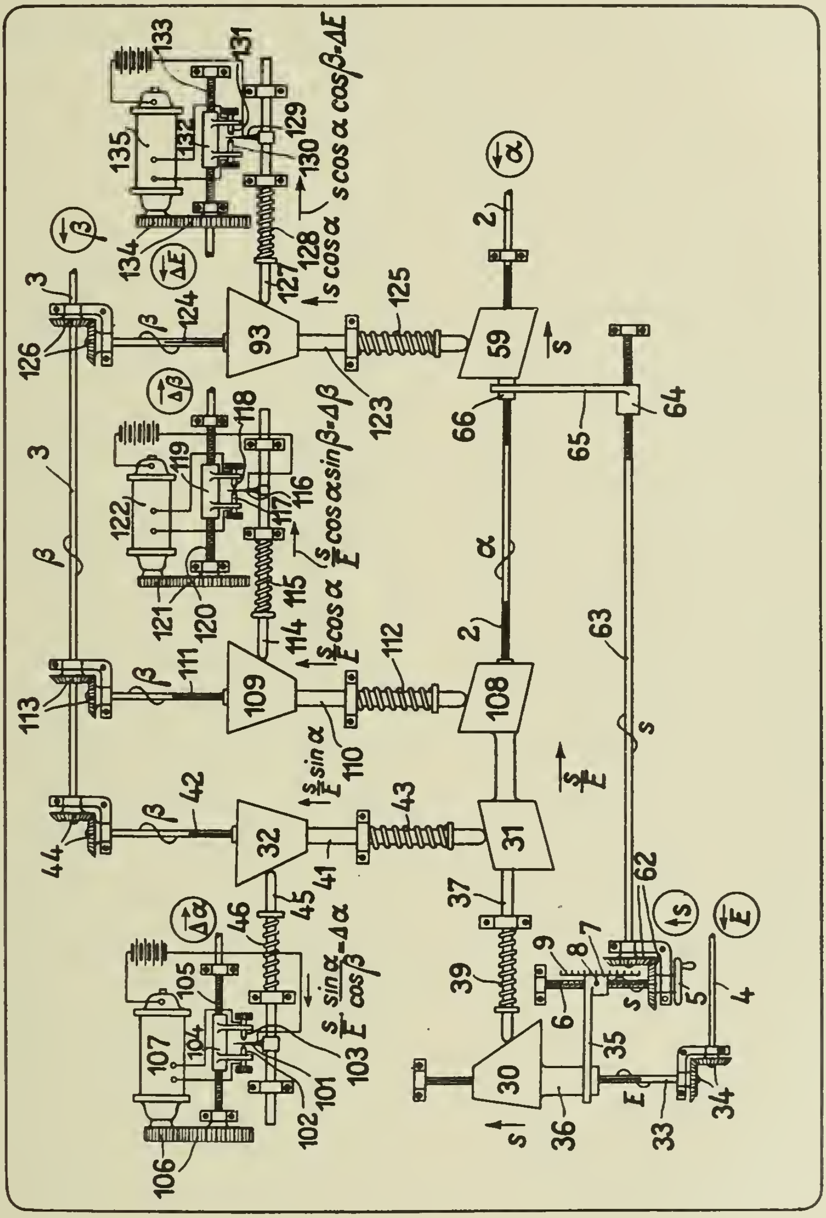

Fig. 4

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Published May 25, 1943 Serial No. 212,674

ALIEN PROPERTY CUSTODIAN

TRAVERSING MEANS FOR WINDING MACHINE

Wilhelm Reiners, M.-Gladbach, Gustav Kahlisch, Rheydt, and Stefan Fürst, M.-Gladbach, Germany; vested in the Alien Property Custodian

Application filed June 9, 1938

This invention relates to means for winding yarn, thread, wire or similar strand materials and refers more particularly to machines for winding yarn into cops, cones, coils, packages, or the like, the strands of which extend crosswise or in helical coils.

Cops and packages of this type are now made on quickly rotating machines by traverse-rolls or drums which serve as the means for guiding the yarn or other strand material. The yarn supplied to these rolls is guided by them and is wound in the form of packages which are usually rotated by frictional engagement with the same rolls.

The point of contact between the yarn and the roll is usually situated substantially in a middle plane intersecting at right angles to the axis of the traverse-roll, and, therefore, it was found necessary to use additional guiding means for the yarn, in order to cause it to move alternatively to the right and to the left of the middle plane. It was customary to use separate thread guides for that purpose, which carry out a rotary reciprocating or oscillating movement, and/or to provide special guiding grooves or slots in the traverse-rolls.

An object of the present invention is to simplify the making of cops, cones, or packages by providing a traverse roll or drum having inclined surfaces which are so arranged that they suffice to cause the yarn or other strand to move in one direction from its middle position and to wind itself upon the cone or package in the form of a helix of predetermined length, whereupon certain additional guiding means are used for the purpose of causing the yarn to reverse the direction of its movement and to return back into its original position.

Another object of the present invention is to utilize the discovery that in winding machines known in prior art the thread has the tendency to move back into the middle plane of the winding as soon as it is free to do so, said discovery being made use of by means of a device which, theoretically, causes the shifting of this middle surface to which the yarn tends to move, toward one end of the winding, thus providing means for automatically returning the yarn to an original position from which it has been moved by the traverse-roll.

A further object is to improve the winding of cones by causing the yarn returning to said original position to be wound in the form of a helix having a slightly diminishing angle of inclination, due to the fact that this diminution of the angle of inclination in a direction toward the wider end of the cone causes larger amounts of yarn to be wound at that end and thereby furthers the formation of the cone.

A still further object of the present invention is to provide an automatic balancing of the yarn tension which is accomplished by using a thread guide to stretch the yarn in a direction which is inclined toward the wider end of the cone, so that the yarn while being wound upon the wider portion of the cone, has not only the greatest speed but is also subjected to the smallest possible friction in the thread guide, and is subjected to greater frictional forces in the thread guide although moving at a lesser speed, while being wound upon the narrow portion of the cone, due to the fact that the angles of inclination of the yarn are smaller at that time.

Still another object of the present invention is the provision of a single machine by means of which the cones can be so wound that their wider sides are situated upon any one of the two sides of the machine.

In prior art traverse-rolls were often used in pairs, the grooves of the second roll causing the return movement of the yarn. Such constructions eliminate the necessity of providing intersecting grooves upon a single roll but increase the costs of installation to a considerable extent; furthermore, the yarn is subjected to great tension due to the fact that it had to be shifted from the groove of one roll to a groove of the other roll at a high speed. A further object of the present invention is to eliminate such drawbacks by providing separate inexpensive and effectively operating means for automatically causing a return movement of the yarn.

The above and other objects of the present invention may be realized by means of a construction which, in its broadest aspect, comprises the combination of means for moving the yarn in one direction and for causing it to return to its original position. In accordance with some of the embodiments of the invention, such means comprise the combination of a traverse-roll having a groove or slot moving the yarn in one direction, with a thread guide which constitutes the means for automatically moving the yarn backwards and which is situated outside of the space limited by planes extending through the side surfaces of the traverse rolls; the groove or slot upon the traverse-roll is, preferably, a helical one, the inclination of the helix corresponding to the direction of the winding of the thread

upon the roll, in the case of a free rearward movement of the thread upon that roll.

The groove or slot upon the traverse-roll should extend in one direction and not intersect any other groove or slot; preferably, one end of the groove or slot should be connected with a special feed groove or slot while the opposite end of the guiding groove or slot is connected with a separate groove or slot for reversing the inclination of the yarn.

Furthermore, in accordance with the present invention, the feed groove or slot and the adjacent portion of the helical guide are widened and are provided with an inclined surface or slot for the purpose of catching the yarn. By means of this arrangement which can be used in combination with a separate abutment limiting the extent of the movement of the yarn, the latter is automatically guided into the groove or slot of the traverse-roll.

When the yarn is being wound in the form of cones, as is customary nowadays, the thread guide determining the inclination of the yarn, is, preferably, situated at the side of the widest end of the cone.

Machines manufactured in accordance with the present invention, may be advantageously employed for the purpose of winding not only cones, but cylindrical packages as well. In that case, however, it is necessary that the inclination of the helical groove or slot should diminish to the same extent to which the inclination of the yarn is diminished in the course of its return movement, the helix determining the inclination of the yarn being its path upon the smooth surface of the traverse-roll in the course of its return movement. By this arrangement the changes in the inclination of the helically wound thread balance each other in the course of the back-and-forth movement of the yarn, with the result that the yarn is wound in uniform and evenly distributed layers in the form of a cylindrical package. The tension of the yarn may be balanced automatically in that case particularly at the time when the angle of inclination of the yarn and, therefore its tension are diminished, through the provision of additional immovable or movable projections which increase correspondingly the friction of the stretched yarn as soon as the angle of inclination of the yarn is diminished. Due to this arrangement, the differences in the yarn tension are also automatically balanced in the course of the winding of cylindrical packages.

In order to be able to use the same traverse roll for the winding of packages of different lengths, the groove which guides the thread is provided with cutout portions of smaller depth at those places at which the yarn should begin its return movement. In order that the yarn should be compelled to start its return movement at one particular cut-out portion, special means are provided for the purpose of covering the deeper adjacent portions of the guiding groove.

In order to wind cones the wide end of which is situated upon any one of the two sides of one and the same machine, the thread guide which determines the inclination of the yarn is made movable in the direction of the axis of the traverse-roll. The original spool from which the yarn is unwound may be made movable along with the thread guide. Through this arrangement, the yarn is always maintained in an inclined position, the direction of which is toward the wider end of the cone.

In certain embodiments of the present invention, the device by means of which the yarn is maintained in its position, is caused to carry out a reciprocatory movement and is caused to change its inclination at the time it changes the direction of its movement, it comprises a bendable supporting surface carrying a number of thread guides, and passing a plurality of spools, although it is also possible to mount separately a thread guide for each spindle or spool and cause this guide to carry out a turning motion in the same direction. Whenever such constructions are used, the yarn may be returned automatically to its original position merely by a reversal of the direction of movement of a thread guide.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings showing by way of example preferred embodiments of the inventive idea.

In the drawings:

Figure 1 shows a device constructed in accordance with the principles of the present invention in front elevation;

Figure 2 is a side elevation of the device shown in Figure 1;

Figures 3 to 6 are detail views showing the yarn in various positions upon the traverse-roll;

Figure 7 shows a grooved traverse-roll cooperating with an immovable friction regulator;

Figure 8 is somewhat similar to Figure 7, but shows a movable friction regulator;

Figure 9 shows a traverse-roll provided with means for winding packages of different lengths;

Figure 10 is a section along the line 10—10 of Figure 9;

Figure 11 shows a traverse-roll provided with slots instead of grooves;

Figure 12 shows a winding device of somewhat different construction in front elevation;

Figure 13 is a top view along the line 13—13 of Figure 12;

Figure 14 shows another winding device of a different form; and

Figure 15 is a top view of the device shown in Figure 14.

Figures 1 and 2 of the drawings show a spool **20**, consisting of a support **21** upon which the thread **22** is wound. A winding device constructed in accordance with the principles of the present invention is used for unwinding it in the form of a helical or cross-winding upon a bobbin **23**, which has the form of a support **24** carried by a shaft **25** and rotatable along with the shaft.

The shaft **25** is rotatably mounted upon one end of a pair of arms **26**, the opposite ends of which are pivotally mounted at **27** upon a frame **28**. The frame **28** may be immovable or may be mounted upon rails in the usual manner (not shown).

As shown in the drawings, the bobbin **23** is in frictional contact with the transverse-roll **30**, so that it may be rotated by that roll. Due to the provision of swingable arms **26**, the bobbin **23** is always in engagement with the roll **30**, while the yarn is being wound upon the bobbin. The traverse-roll **30** is firmly connected with a shaft **31**, which is mounted upon projections or supports **32** of the frame **28**. The shaft **31**, which is firmly connected with the roll **30**, is driven by any suitable mechanism not shown in the drawings.

Obviously, several spools **20** and traverse-rolls **30** may be situated side by side in the plant, and

the rolls 30 may be mounted upon the same driving shaft 31 or upon separate shafts.

In accordance with the present invention, the spool 20 and the thread guide 29 which stretches the yarn 22, are situated to the right of a vertical plane passing through the middle of the roll 30 and indicated diagrammatically by the letters $x—x$ in Figure 1 (looking in the direction of Figure 1). Furthermore, it is preferable and even advisable to arrange the spool 20 and the thread guide 29 in such manner that they are situated to the right of a plane passing through the right-hand side surface of the bobbin 23, said plane being indicated diagrammatically by the letters $y—y$ in Figure 1.

According to another definition, the spool 20 and particularly the thread guide 29 should be located outside of the space which is limited by two planes passing through the two side surfaces of the traverse roll 30. These two planes are diagrammatically indicated in Figure 1 by the lines $u—u$ and $v—v$.

It has been found that when the thread guide is disposed in this manner, the yarn 22 will assume the most advantageous angle of inclination and may be easily and conveniently wound upon the bobbin 23 without the necessity of using any oscillating guiding means or traversrolls of a complicated form.

A rod or abutment 33 is carried by the frame 28 and is used for the purpose of limiting the movement of that portion of the yarn 22 which is close to the traverse-roll 30, toward the right. The abutment 33 is preferably situated underneath the traverse roll 30 and close to the surface $v—v$ passing through the right-hand side surface of the roll 30.

The traverse roll 30 is provided with a groove 34 extending in the form of a single uninterrupted and unintersected helix substantially from one side surface of the roll 30 to the opposite one. The left-hand end portion 35 of the helical groove 34 is in communication with a short groove 36 extending in an opposite direction to the groove 35 and constituting a means for reversing the direction of inclination and of movement of the thread 22.

The opposite end 37 of the helical groove 34 is in communication with another short groove 38, which extends in substantially the same direction as the reversing groove 36 and which may be designated as the receiving groove. The two grooves 36 and 38 are comparatively short, they do not have the form of a helix and in no way approach or intersect the helical groove 34.

Due to the fact that the groove or cavity 38 extends at an angle to the helical groove 34 and its end portion 37, a projection or abutment 39 is formed, one edge of which is leveled off to provide an inclined surface 40 constituting one of the surfaces of the end portion 37 of the groove 34 and serving the purpose of receiving the thread 22.

Due to this arrangement, the grooves formed upon the roll 30 easily receive the thread 22 and hold it securely, and the direction in which the thread 22 extends can be changed easily and conveniently even though the roll 30 may be driven at a high speed.

The manner in which the thread 22 is guided by the traverse-roll 30 is indicated in Figures 1 and 3 to 6 of the drawings. The yarn 22 engages the end 37 of the helical groove 34 and is guided by this groove, as shown in Figure 1, until it completes its movement from right to left and reaches the end 35 of the groove 34. This end position at which the yarn 22 is shifted from the end portion 35 of the helical groove 34 into the groove 36 and begins its return movement, is illustrated in Figure 3.

Due to the location of the thread guide 29 to the right of the traverse-roll 30, the guide 29 causes the yarn 29 to assume an inclined position upon the roll 30 and pulls it out of the grooves, whereupon the yarn will carry out its return movement upon the smooth surfaces of the roll. After the roll has been rotated twice the yarn 22 will have the position shown in Figure 4, the path of the yarn upon the smooth surfaces of the traverse-roll 30 being shown by broken lines in Figures 4 and 5.

Then after one more revolution of the traverse-roll 30 the yarn will reach the right-hand end of the roll thus completing its return movement and will then be caught in the groove 38. The rod 33 which limits the movement of the yarn to the right, will change the direction of the yarn as soon as it is in contact with it and will facilitate the insertion of the yarn into the groove 38. This position is shown in Figure 5. Then the yarn is guided again in the groove 34 and is caused by that groove to move toward the left, Figure 6 showing the yarn in the course of its forward movement after the traverse-roll has completed two revolutions.

It will be noted that the position of the thread guide 29, which determines the direction in which the yarn 22 extends, forces it to be wound helically upon the winding 23 in the course of the return movement of the yarn. The helical line which represents the path of the yarn 22 upon the smooth surfaces of the traverse-roll 30, has a pitch or angle of inclination which diminishes somewhat toward the right-hand end of the roll 30.

Therefore, due to the described cooperation of the helical groove 34 which moves the yarn in one direction and the thread guide 29 which due to its position, pulls the thread in a different direction as soon as it leaves the groove 36, the yarn is wound in substantially uniform cross windings which result in the formation of a cone 23.

This arrangement may be advantageously used for the purpose of winding cylindrical packages 50, illustrated in Figures 7 and 8. In order to wind the yarn 22 in the form of a cylindrical package, it is necessary to provide a traverse roll 51 having a helical groove 52 the angle of inclination of which diminishes in the direction away from the thread guide 53, for example, in the constructions shown in Figures 7 and 8, toward the left side of the traverse-roll.

The winding of cylindrical packages as compared to the winding of cones, has the disadvantage that in the course of the former the differences in the tensions of the yarn do not balance each other automatically, although such automatic balancing takes place in the course of the making of cones, due to the inclined position of the yarn in the course of the winding. Therefore, when winding cylindrical packages, it was found desirable to provide a second thread guide 54 which is situated closely to the thread guide 53 in the position shown in Figure 7, and which cooperates with the thread guide 53 for the purpose of balancing the thread tension.

This balancing is attained by the two thread guides 53 and 54 due to the fact that the yarn is subjected to greater frictional forces when it is situated upon the right-hand end of the traverse

roll 51, while at the same time it has the smallest angle of inclination. On the other hand, when the yarn 22 is situated upon the left-hand side of the roll 51 and has the greatest angle of inclination, it practically does not touch the thread guide 54 at all and is subjected to considerably smaller frictional forces.

Obviously, the effect attained by using two thread guides 53 and 54 may be further enhanced by employing whenever necessary a larger number of thread guides.

The device shown in Figure 8 comprises a traverse-roll 61 which may be used for the purpose of winding a cylindrical package 50. The traverse-roll is rotatable along with the shaft 60 which carries a worm 62.

The yarn 22 is guided by two immovable thread guides 63 and 64 and a movable thread guide 65 which comprises a projection or rod 66 mounted upon one end of a double-armed lever 67 which is rotatably mounted upon a pivit 68 carried by a support 69. The opposite end of the lever 67 is pivotally connected at 70 with a rod 71 which is eccentrically mounted at 72 upon a toothed wheel 73 meshing with the worm 62. The gear wheel 73 is rotatably mounted upon a support 74 which may be integral with the support 75 for the shaft 60.

The yarn 22 usually is engaged by the thread guides 63 and 64 while the action of the movable thread guide 66 upon the yarn 22 is an intermittent one. The worm 62 which rotates along with the shaft 60 of the roll 61 reciprocates the rod 71 carried by the gear 73, thereby swinging the double-armed lever 67 around its pivot 68. In the course of this oscillating movement the thread guide 66 engages the yarn 22 and then recedes again, this movement depending upon the position of the traverse roll 61 in the course of its rotation.

The device is set in such manner that the movable thread guide 66 exerts its greatest frictional force upon the yarn 22 at a time when the thread has its smallest inclination, namely, when it is at its right-hand position which is indicated in Figure 8. On the other hand with the movement of the yarn toward the left and with the increase of the angle of inclination of the yarn, the movable guide 66 gradually recedes until it is practically or entirely out of contact with the yarn at a time of the latter's greatest inclination, namely, when it is at the left end of the traverse-roll.

Figures 9 and 10 illustrate a device by means of which it is possible to vary the length of the winding. In the constructions illustrated in Figures 1 to 8, the length of the conical winding 23 or of the cylindrical package 50 is determined by the length of the traverse-roll, so that whenever a package of a different length is desired it is necessary to use a different traverse-roll. On the other hand, by means of the construction shown in Figures 9 and 10, it is possible to wind packages of different lengths by means of the same traverse-roll.

The traverse-roll 80 shown in Figures 9 and 10 comprises grooves 81, 82 and 83 which are substantially similar to the grooves of previously described traverse-rolls. The roll is mounted upon a shaft 84 which is rotated by any suitable mechanism, the other details of the winding mechanism being substantially similar to those described. In accordance with the present invention, a portion of the wall 85 of the helical groove 81 is planed off, thus providing a somewhat flattened surface 86 which terminates in a raised flat projection 87. The projection 87 is situated at a point at which the direction of the yarn 22 may be reversed whenever it is decided to wind a package 88 which is shorter than the normal length of the roll.

As is shown in Figure 10, the yarn 22 is not affected by the projection 87 and is not caused to reverse its movement so long as it is situated at the bottom of the groove 81.

However, in accordance with the present invention, the yarn 22 may be raised from the bottom of the groove 81 by means of a rod 89 which may be inserted into a suitable opening or bore hole which extends parallel to the shaft 84 across one or more windings of the helical groove 81.

Whenever the rod 89 is situated within its opening, the yarn 22 is raised from the bottom of the groove 81 and caused to engage the projection 87, thereby slipping out of the groove 81 and reversing its direction.

Due to this arrangement, simple and effective means are provided for the purpose of limiting the length of the package. Obviously, any number of projections 87 may be provided in suitable places upon one single traverse-roll and rods of different lengths may be used for the purpose of causing the yarn 22 to reverse its direction at any suitable portion of the roll.

The heretofore described traverse-rolls consist of a cylindrical body the outer surfaces of which are provided with the guiding grooves. However, such rolls may be conveniently substituted by hollow rolls, one of which is illustrated in Figure 11 of the drawings. The roll 90 of Figure 11 is hollow and comprises an outer casing 91 having a helical slot 92 extending from one side of the casing to the other and functioning in substantially the same manner as the groove 34 of the traverse-roll 30 shown in Figure 1.

One end of the helical slot 92 is in communication with a short reversing slot 93 while the opposite end of the slot 92 is in communication with a wider receiving slot 94. The two slots 93 and 94 operate in substantially the same manner as the grooves 36 and 38 of the roll 30 (Figure 1).

The roll 90 is also provided with a hook-shaped projection 95 which is situated close to the point of juncture of the slots 94 and 92. A catching slot or recess 96 is provided close to the projection 95 and is used for the same purpose as the inclined surface 40 (Figure 1), namely, for the purpose of receiving the yarn.

The device shown in Figures 12 and 13 of the drawings comprises a traverse-roll 100 which is rotatably mounted upon a shaft 101. The shaft 101 is carried by a support 102 which may constitute a part of the frame. The roll 100 is used for the purpose of guiding the yarn 22 which is wound in a cone 103. This roll is provided with a smooth cylindrical surface 104 and has no helical grooves at all. In accordance with this form of the invention, the reversal of the direction of movement of the yarn is caused by short grooves 105 to 108 which are situated in pairs upon opposite sides of the roll 100.

The shaft 101 carries a gear wheel 109 which meshes with the horizontal gear wheel 110. The gear wheel 110 is rotatably mounted upon the vertical shaft 111 so that the shafts 101 and 111 rotate simultaneously, the shaft 101 being driven by any suitable mechanism not shown in the drawings.

A disk or pulley 112 is rotatably mounted upon

the shaft 111 and may have the form of a swift the diameter of which can be changed at will. An endless belt 113 only one side of which is shown in the drawings, passes over the disc 112. The speed of travel of the endless belt 113 may be easily varied by means of the swift 112. The belt 113 carries a number of thread guides 114 and 115 which move along with the belt. Another immovable thread guide 116 has the form of a hook which extends above the endless belt 113 and below the left-hand side surface of the traverse roll 100.

In accordance with the present invention, the spool 20 from which the yarn 22 is unwound may be mounted upon a carriage 117 mounted upon wheels 118. The carriage 117 may be moved mechanically or by hand and may have the form of elongated rails carrying several spools 20, each spool being provided with a separate thread guide 119 which is also mounted upon the carriage 117 and which performs the same function as the thread guide 29 shown in Figure 1.

When the device is in operation the spool 20 should be situated in the position shown in full lines in Figure 12. The yarn 22 is originally guided by the groove 108. At the same time the thread guide 114 engages the yarn 22 and due to its movement along with the endless belt 113 shifts the yarn gradually toward the left, while it is being wound in helical coils upon the cone 103. When the yarn 22 reaches the groove 105 it is compelled to reverse its direction by the groove 106 and at the same time the yarn is brought into engagement with the thread guide 116 which slips the yarn 22 off the thread guide 114. Then due to the inclination of the yarn 22 caused by the position of spool 20, the yarn is again wound in helical windings which intersect the original windings, until it reaches the grooves 107 and 108. At that time another thread guide carried by the endless belt 113 is brought into engagement with the yarn and the operation is repeated.

While Figures 12 and 13 are intended to show the formation of a left-hand spool body, Figures 14 and 15 show the formation of a right-hand spool body, with thread guides of a somewhat different type.

The device in Figures 14 and 15 comprises a horizontal driving shaft 120 which is operated by any suitable mechanism not shown in the drawings. The shaft 120 carries a toothed wheel 121 which meshes with the toothed wheel 122 carried by the shaft 123 of the traverse-roll 124 which is substantially similar to the traverse-roll 100 (Figure 12). By means of this arrangement the shaft 120 drives the traverse-roll 124 which is in frictional engagement with the winding or package 103.

The driving shaft 120 also carries a conical gear wheel 125 which meshes with a gear wheel 126 carried by the vertical shaft 127. The shaft 127 carries a horizontal disk or table 128 the outer circumference of which is provided with a projection constituting a thread guide 129. Another projection 130 has the form of a hook and is situated adjacent the left-hand end of the traverse-roll 124.

The operation of this device is substantially similar to that of the device described in Figures 12 and 13. The thread guide 129 of the table 128 shifts the yarn 22 from right to left until the left end edge of the traverse-roll 124 is reached and until the yarn 22 is situated in the grooves 131 and 132 of the roll. At that time the hook-shaped thread guide 130 causes the yarn 22 to slide off the thread guide 129 and due to the inclined direction of the thread caused by the position of the spool, the yarn is wound in a direction toward the right-hand side of the roll 124 until it reaches the grooves 133 and 134 of that roll. At that time the projection 129 is again brought into engagement with the yarn 22 and shifts it again toward the left, thus repeating the operation.

It is apparent that the specific illustrations shown above have been given by way of illustration and not by way of limitation and that the structures above described are subject to wide variations and modifications without departing from the scope of the invention. For example, the constructions show in Figure 12 to 15 may be used in connection with individual or movable spool bodies and any suitable thread-guiding device may be used for the purpose of shifting the yarn along a traverse-roll in one direction, the return movement being accomplished by the described position of the spool creating a suitable inclination of the yarn. All of such and other variations and modifications are to be included within the scope of the present invention.

The terms "yarn" and "thread" as used in this specification and claims are intended to include wire and other strand material, while the terms "winding" and "package" are intended to include cops, cones, coils and the like.

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PUBLISHED MAY 25, 1943. BY A. P. C.

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TRAVERSING MEANS FOR WINDING MACHINE

Filed June 9, 1938

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Fig. 1.

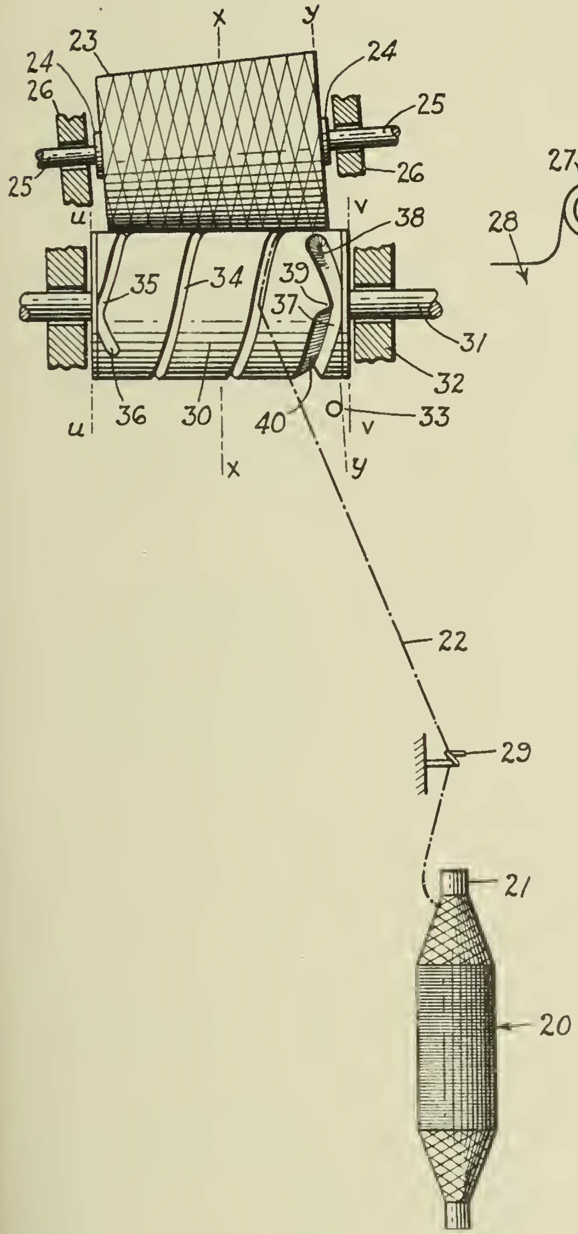
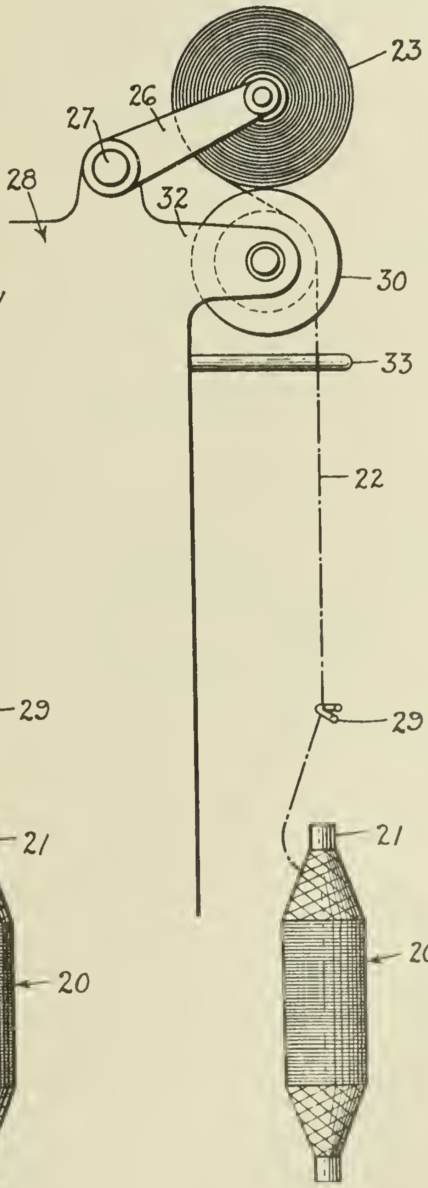


Fig. 2.



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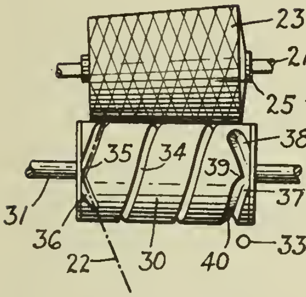


Fig. 3.

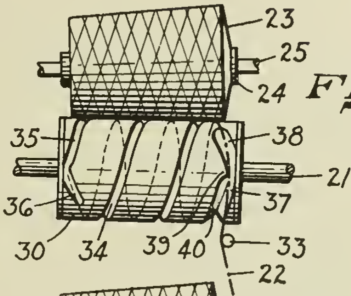


Fig. 5.

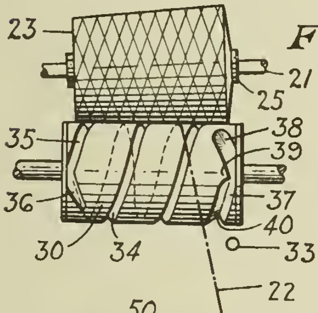


Fig. 4.

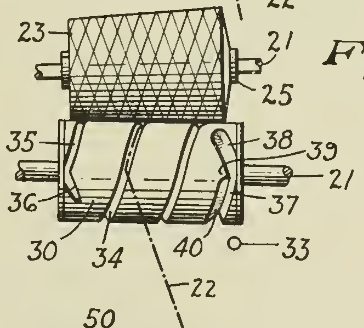


Fig. 6.

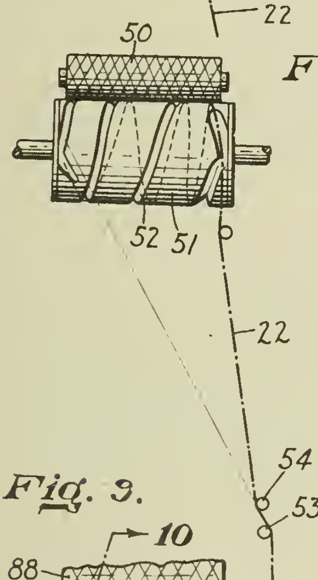


Fig. 7.

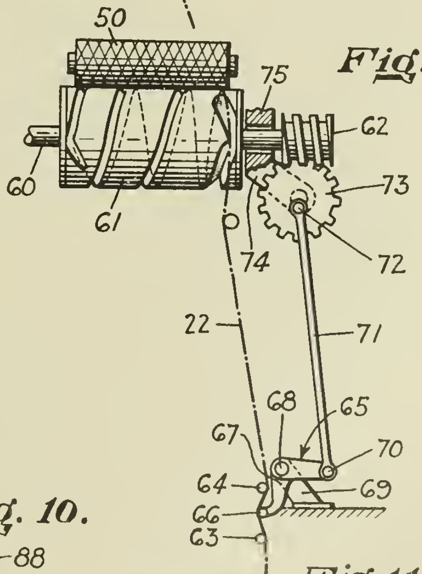
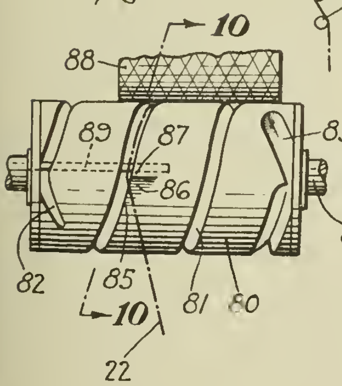


Fig. 8.

Fig. 9.



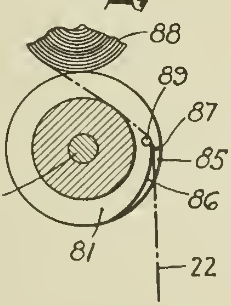


Fig. 10.

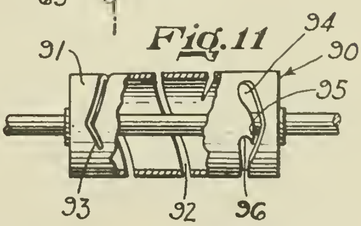


Fig. 11

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Fig. 12.

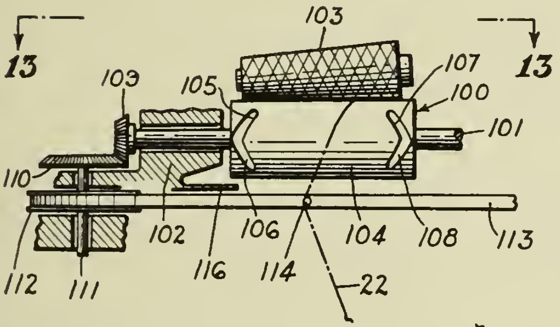
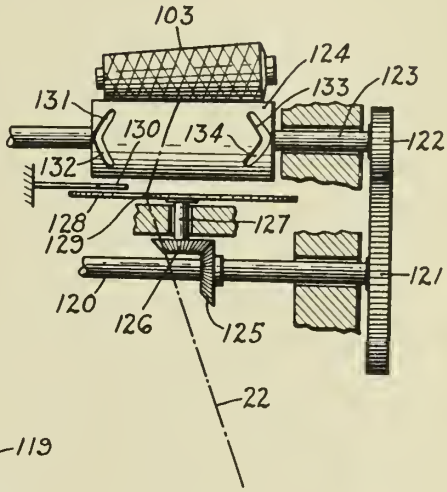


Fig. 14.



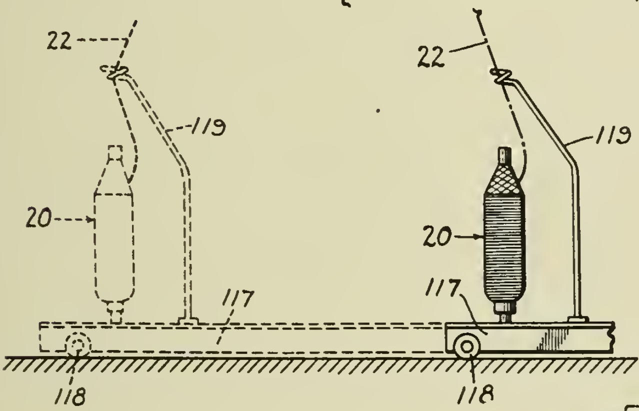


Fig. 15.

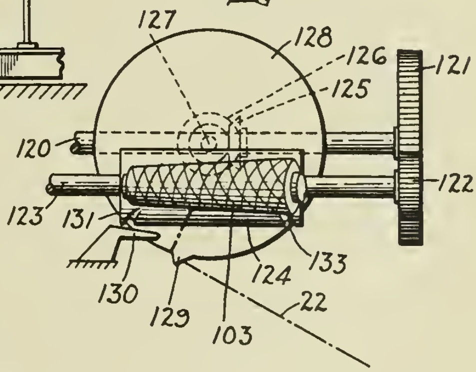
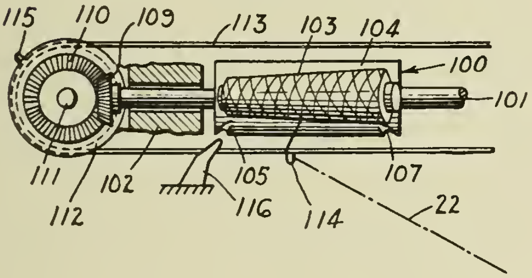


Fig. 13.



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Published May 25, 1943 Serial No. 213,689

ALIEN PROPERTY CUSTODIAN

PROCESS AND MEANS FOR PURIFYING WATER

Eugène Joseph Desroches, Courbevoie, France; vested in the Alien Property Custodian

Application filed June 14, 1938

The present invention, which is due to Mr. Eugène Desroches, relates to the art of purifying, preliminary filtration and filtration of water.

In the present processes, it is often necessary to decant for a long time, after the ingredients have been introduced. It is nearly always aluminum and iron salts that are used, and this causes the formation of colloids, but also of calcium sulphate or chloride, which are undesirable substances. Water thus treated soon clogs the apparatus.

The invention has for its object to overcome these drawbacks and, more particularly, to eliminate or considerably reduce decantation by introducing into the water to be treated ingredients such that, with the substances contained in the water, a porous complex is obtained which gives little loss of head in the apparatus and facilitates cleaning.

Said ingredients are:

(1) Elementary substances in powder (zinc, iron, carbon, etc.).

(2) Acids, the salts of which, apart from those they form with the alkaline metals, are insoluble, viz.: phosphoric, boric, silicic, fluosilicic, carbonic, etc. acids.

(3) Strong bases, in particular lime.

(4) Substances readily yielding lime or oxygen (calcium dioxide, calcium hypochlorite, calcium permanganate, etc.).

(5) Natural or artificial compounds which are insoluble in water: the oxides, hydroxides, carbonates, phosphates, borates, silicates, fluosilicates, of calcium, of magnesium, of zinc, of iron, of manganese, of aluminum, of chromium, of lead, of copper, etc.

(6) The complex compounds known by the name of cements, natural or artificial pozzolanas, in which must be included blast-furnace slag, various clinkers and scoriae, dephosphorization scoriae, etc.

(7) Celluloses and particularly celluloses that readily go into suspension, such as cellulose wool, alfa sponge.

(8) Resins and gums.

All these solid products have to be finely pulverized. It is not necessary for them to be pure, a fact which generally permits the use of natural rocks, industrial products and by-products.

As the nature of the water varies from one region to another and with meteorological conditions and users' requirements are likewise variable, a large number of ingredients have been mentioned above, in order to meet all requirements.

By way of example, a treatment is given hereunder which applies to water containing carbonic acid, whether such water be too acid, too soft, too hard:

(1) Aeration.

(2) Introduction of the sterilizer.

(3) Introduction of lime in excess, that is to say in greater quantity than that necessary for neutralizing the carbonic acid.

(4) Introduction of one or a plurality of the substances mentioned above (with the exception of the simple compounds of calcium), so as to absorb the excess of lime and cause the formation of a porous complex. Pozzolanas are particularly suitable and scoriae of dephosphorization have the advantage of producing sludge that can be used for agriculture.

The aeration can often be eliminated (particularly if preliminary filtering materials with aeration are used) and also the introduction of a sterilizer. The introduction of lime is only useful if there is carbonic acid in the water. In certain cases (some ferruginous waters for example) it is necessary to rely solely on aeration, which is effected either beforehand, or by passing through the preliminary filtering materials.

Experience has shown that for numerous applications, the addition, to the water to be treated, of an excess of lime with respect to the substances contained in the water, then of pozzolanas, by causing the formation of a porous complex, is advantageous in many cases.

This method of treatment with lime and pozzolanas is particularly advantageous in the case in which carbonates have to be eliminated (softening of water), for removing the iron, for removing the manganese from water.

In this connection, it should be noted that by pozzolana should be understood, according to the invention, in a general manner, a substance which forms stable and insoluble compounds with free lime, at the ordinary temperature.

As, for the treatment of water, questions of mechanical strength do not have to be taken into consideration as for pozzolana mortars, the word pozzolana applies, in the spirit of the invention, in addition to the substances formed by silica, alumina, or silicates:

(1) to elementary substances in powder which are insoluble (iron, zinc, carbon, etc.);

(2) to all forms of silica (fossil silica, Tripoli silica, etc.);

(3) to celluloses, resins and gums;

(4) to the natural or artificial compounds formed by the following substances, alone or

a layer at the upper part of the preliminary filter, instead of being distributed in the water.

The most suitable quantity of air to be introduced is determined experimentally. Its rate of flow may vary from 0 to 200 times that of the water, the maximum applying to water which is heavily charged with organic materials.

It should be observed that the softening of water is obtained both with the filters of the various systems and with the preliminary filters and that previous sterilization may always be provided (as far as possible with calcium compounds, or pure gases). In the case of water that is heavily charged with organic materals, it is advisable, in order to obtain an economical operation, to pass the water first of all over a preliminary filter with air suction, without any other ingredient than lime or carbonate of lime if the water is acid.

When the water is heavily charged, it is advantageous to start the filters by first of all supplying clean water in which the selected ingredients have been introduced.

It can be seen that the process according to the invention permits of the most varied applications. For example, to convert very heavily charged water (drain water, for example) into drinkable water, the operation may be carried out in the following manner:

(1) add lime or carbonate of lime, in the case of acid water;

(2) pass the water over a preliminary filter with intense aeration, the air circulating in the same direction as the water;

(3) introduce an ingredient;

(4) pass over a second preliminary filter;

(5) introduce an ingredient;

(6) filter.

Summary decantations may be effected, if necessary, between the phases (3) and (4).

In certain cases, it is more advantageous to effect a first decantation, using solely powdered natural carbonate of lime.

If sewage has been poured into the drain-water, it may be necessary from time to time to remove the superficial layer which forms on the first preliminary filter, said layer being then, for example, subjected to fermentation in an appropriate cell.

EUGÈNE JOSEPH DESROCHES.

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E. J. DESROCHES

PROCESS AND MEANS FOR PURIFYING WATER

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Fig. 1.

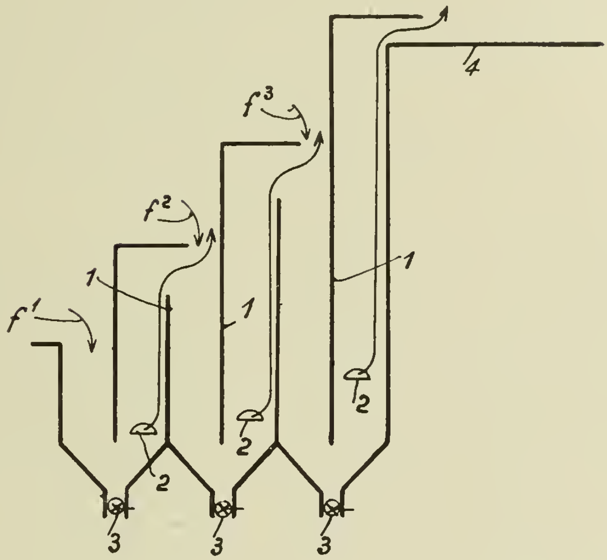
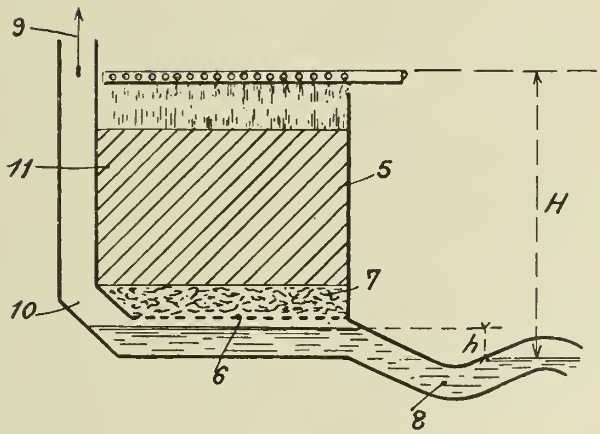


Fig. 2.



E. J. Desroches
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By: Glascock Downing & Seebold
Attys.

Published May 25, 1943 Serial No. 215,248

ALIEN PROPERTY CUSTODIAN

METHOD AND APPARATUS FOR ELECTRICAL RESISTANCE WELDING

Gerhard Hagedorn, Berlin-Halensee, Germany; vested in the Alien Property Custodian

Application filed June 22, 1938

For the short period connection of resistance welding machines, use is made at the present time of large mercury vapour switching vessels which are connected directly or indirectly in the primary circuit of the welding transformer. These large switching vessels are very expensive and, owing to their great sensitiveness to shaking, are suitable only for stationary installations. The object of the present invention is to avoid the use of these expensive switching vessels in the primary circuit of the welding transformer, which vessels are moreover not very reliable.

The invention relates to a method of electrical resistance welding and it consists in that the temporarily short connections and regulation of the intensity of the welding current is effected by means of a choking coil with iron core inserted between the source of welding current and the welding transformer for the resistance welding, the choking capacity of which choking coil is due to a magnetic flux produced by a continuous current coil mounted on the iron core. The continuous current is controlled as regards its intensity and duration by a current or voltage regulator and a time regulator. Preferably a short circuiting switch connected in parallel with the welding transformer, or a cut out connected in series with the welding transformer, is used for the purpose of reducing the current in the transformer completely to nil during the intervals of rest between the welding periods.

The welding transformer may be operated by an alternating current of 50 or 60 periods. However, it is an advantage to supply a current of middle or high frequency to the transformer, more particularly an alternating current of, for instance 300 to 20,000 Hz.

The invention also relates to an apparatus for carrying into effect the method hereinbefore referred to, which apparatus comprises a source of welding current, a welding transformer for resistance welding connected to the said source, a pre-magnetised choking coil operated by direct current and inserted in the primary circuit of the welding transformer and a source of direct current with a regulating device for the intensity of the current and the period of connection of the said direct current choke.

A further feature of the apparatus is that it comprises a short circuiting switch connected in parallel with the welding transformer or a cut out connected in series therewith. The source of welding current may consist of a generator driven by a motor, preferably a generator of middle or high frequency currents, and the driving motor may operate at the same time the switching means controlling the direct current for the control of the choking coils and switches.

The use of the choking coil pre-magnetised by direct current as a short time switch for the resistance welding machines also offers substantial technical advantages. Thus, for instance, results may be obtained, such as are obtained by the known expensive switching devices, but which are cheaper and in a more reliable manner. Only a small fraction of the welding output has to be switched on and off.

Moreover, the direct current side of the choking coil receives current, preferably from a rectifier, the grid of which is controlled by mechanical controlling means, such as switching cylinders mechanically coupled with the generator. The slip rings of the switching cylinders are coated with the material of the brushes when used for some time, which, owing to the small value of the grid currents, may cause disturbances. Also this disadvantage is avoided by the present invention. Moreover the manipulation of the installation, more especially as regards time adjustments, is considerably facilitated, so that the series of welding spots is quickly produced.

A further feature of the invention consists in that the mechanical control of the grids of the rectifier feeding the direct current side of the choking coils is replaced by a purely electric short period control arrangement by which a grid voltage, which is positive with respect to the cathode, is supplied for a selected period of time to the grids of the rectifier having two or more anodes. The positive gradually dropping grid voltage is produced by the discharge of a condenser, which discharge may preferably be controlled by an auxiliary tube, the grid of which is controlled synchronously with the network feeding the rectifier. The discharge of the condenser may be effected by a hand-operated key. In the case of seam-welding the key may be operated mechanically, so that any desired series of spots may be obtained. A synchronously-operating interrupter for producing the intervals of rest of the welding may be arranged in the grid circuit of the auxiliary tube.

The invention is illustrated diagrammatically and by way of example in the accompanying drawings and showing three different arrangements.

Fig. 1 is a diagram of connections of a resistance spot welding installation in which a choke switch premagnetised by a direct current is in-

serted in the primary circuit of the welding transformer,

Fig. 2 is a diagram of connection of a resistance spot welding installation with a choke switch pre-magnetised by a direct current inserted in the primary circuit of the welding transformer, as well as the controlling device for the rectifier which supplies the direct current for the choke switch,

Fig. 3 shows a portion of a diagram of connections in a resistance seam welding installation, and

Fig. 4 shows the relationship between the grid voltage and the welding time and the position of the controlling contact in the case of seam welding.

Referring to Fig. 1, 1 is a welding generator, for instance for middle or high frequency currents, the field 2 of which is supplied with current from a direct current network 3, through a switch and regulator 4. The excitation current can be adjusted to the necessary requirements. The welding generator 1 is connected to the welding transformer 5, the secondary 6 of which is connected to the welding electrodes 7 and 8 between which the welding material, for instance two metal sheets 9 and 10 to be welded, is placed. The primary coil 11 of the welding transformer is connected in parallel with a short circuiting circuit 12 containing a short circuiting switch 13. A choke switch 15 is inserted in the connection 14 between the welding generator and the welding transformer, which switch comprises, for instance, a three-limb magnetic core 16 and a direct current excitation winding 17. 18 and 19 are the alternating current coils. The direct current winding 17 is energised by rectified alternating current through the mercury vapour rectifier 20 receiving current, for instance, from the generator 1. The control of the rectifier is effected through the grid 21.

The welding generator 1 is driven by means of a motor 23 energised from the three-phase network 22, which motor drives through a change speed gear 24, the controllers 27, 28, 29 and 30, and through a further change speed gear 31, the controllers 32 and 33.

The controllers 27 and 28 are connected through a source of current 34 to the electromagnetically operated short circuiting switch 13. The choking coil is small if the inductivity is not chosen too high for the zero value of the direct current. On the other hand the minimum value of the alternating current increases therewith. Therefore it is an advantage during the interval of rest of the welding to short circuit the transformer or disconnect it by means of a switch. The switch which has to deal only with a small output and may be constructed as a dry switch, controller, or as a switching vessel, is preferably coupled to the controlling shaft for the direct current circuit as shown. Instead of the short circuit switch use may be made of a cut out which is opened in the intervals of rest of the welding. The controllers 29, 30, 32, 33 operate one of the known grid control arrangements consisting of a source of direct current voltage 36 for the positive and 35 for the negative grid voltage and a protecting resistance 37. Moreover the switch 38 can be used to stop the operation of the installation. 39 are the two anodes of the rectifier. The connection is effected, for instance, over the step transformer 40 to the generator 1. In addition to the step transformer the regulation of the voltage may also be effected by suitably choosing the ignition angle for the grids 21.

The controllers 29 and 30 may be used for adjusting the time of welding, for instance, by displacing the one controller 30. Further, the adjustment may be effected by varying the speed, by means of the change speed gear 24. The controllers 27—28, which are constructed and arranged in the same way as the controllers 29—30, disconnect the switch 13 during the welding periods, whereby the short circuit of the transformer is removed. The controllers 32, 33 adjust the periods of rest of the welding. If the number of revolutions of 32, 33 is half that of 27, 28, then one welding period is left out. If it is one-third thereof, then two periods are left out, and so on. The greater the ratio of transmission of the change speed gear, the greater is the interval between the individual welding spots. With increasing transmission ratio the segment covering of the controllers 32, 33 must be made so small that the period of closure coincides with the period of welding.

In this way, welding periods below $\frac{1}{100}$ths of a second can be obtained, so that this method is useful, also for light metal welding.

A further advantage of the method consists in that the intensity of the welding current can also be easily varied, for instance, in the example shown in Fig. 1, by regulating the direct current voltage of the rectifier by means of the grids.

Since the output to be dealt with is small, any desired switches may be used, for instance, relays, cam switches, controllers etc. Use may also be made, for energising the direct current coil, of a separate small direct current generator, the excitation of which is controlled.

The method described is especially suitable for high frequency welding installations, since the magnetic flux of the choke and, therefore, the choke itself, are small. In the case of high frequency currents therefore it is possible to obtain very short periods of welding. Also the direct current output for the magnetising coil is reduced, which results again in a reduction in the size of the whole of the direct current circuit.

Referring to Fig. 2, the source of alternating current supplying the welding current, for instance an alternating current generator 1, is connected to the primary coil 11 of the welding transformer through the choke switch 15, which is pre-magnetised by direct current, the said switch being, for instance, provided with a three-limb magnetic core 16 and alternating current coils 18 and 19. The choke switch is also provided with a direct current excitation winding 17. The welding transformer is provided with an iron core 5 and a secondary core 6, which is connected to the two welding electrodes 7 and 8 arranged to spot weld the metal sheets 9 and 10.

The rectifier 42, provided with controlling grids 78, 79 and 80 supplied with current from a three-phase network 41 over protecting resistances and switches, supplies current over a resistance 43 to the direct current winding 17 of the choke switch 15, the ends of which are connected to a condenser 44. The conductor 45 leads through a switch and protecting resistance to the star point 46 of the network.

The three-phase network 41 supplies current through protecting resistances and switches through a phase shifter and an adjustable resistance 48 and a highly saturated choking coil 49 to the grid transformer 50, which supplies the

grid voltage through a resistance 51 for the gas or vapour discharge path, for instance of an incandescent cathode tube 52. The contact key 53 connects, in the position illustrated in the drawing, the condenser 54 supplying the positive grid voltage for the rectifier 42 over a resistance 55 to the positive pole of an auxiliary rectifier 56. By operating the key 53, the condenser 54 is discharged through the tube 52, so that a positive grid voltage is imparted to the rectifier 42, whereby the direct current of the choke switch 15 is switched on.

59 and 60 are batteries which supply the negative grid voltage biases. 61, 62, 63 and 64 are resistances. The battery 65 supplies the heating current for the cathode 67 of the grid controlled auxiliary tube 52 with the grid 68 over an adjustable resistance 66.

The starting anode 69 of the rectifier 42 is supplied with current, for instance from a starting battery 70, over a resistance 71. Further, an auxiliary transformer 72 receives current from the three-phase network 41 over protecting resistances and switches, which transformer in its turn supplies current to two continuously working auxiliary electrodes 73 and 74 of the rectifier 42. 75 is a resistance and 76 a choking coil.

As regards the operation of the installation, the following is further to be pointed out:

In the improved method, a voltage dropping in the selected period of welding from a value which is positive with respect to the cathode down to a stopping value is supplied to the grids 78, 79, 80 of the rectifier 42 by the discharge of an energy accumulator, for instance a condenser 54.

By using the choke switch supplied with current from the rectifier 42, the great advantage is attained that the rectifier installation is very small and that, therefore, a switching device according to this principle is useful, even for transportable welding plants.

A very simple way consists in charging a condenser and discharging it through resistances, grids and cathodes. In this very simple form the principle is suitable only for a long duration of welding, since the latter depends on the moment of switching on. In the case of three-phase rectifiers and 50 Hz the difference may, for instance, be up to 6.6/1000 seconds. It is possible to use the arrangement also for short periods of welding, by discharging the condenser through a gas or vapour auxiliary path of discharge, for instance the tube 52. When the key 53 is in the position of rest, the condenser 54 is charged by a source of direct current 56. When the key is pressed down, the condenser 54 is discharged through the auxiliary path of discharge, viz. the tube 52, and through the current path leading to the cathode, but only from the moment when, by means of the grid transformer 50, the stop potential of the battery 59 is rendered ineffective. The grid transformer 50 is fed from the network 41 feeding the rectifier, over a phase shifter 47 and a highly saturated choking coil 49. The first measure causes that the starting always takes place at the same moment with respect to the alternating current voltage, and thus always starts the same anode of the rectifier with the same angle of phase. The saturated choke acts in the known manner. The secondary voltage of the grid transformer is greatly distorted and becomes very pointed. One thus obtains sharp points of intersection with the starting core line of the auxiliary tube 52.

The adjustment of the time of welding is best effected by properly choosing the size of the condenser. In the case of welding times below half a wave, the starting and therefore the period of welding can be adjusted by means of the phase shifter.

By means of the new switching method, the switching of the time can be carried out exactly and regularly. Moreover a very quick series of spot welds can be obtained, since, after the key has been released, the plant is again quickly ready for operation since the charging of the condenser takes only a very short time. Besides the simple key one does not require any parts which are movable or subject to wear. By means of a mechanical drive of the key the arrangement may be rendered useful for seam welding.

Fig. 3 shows the modification of the arrangement according to Fig. 1 for electrical seam welding. The rectifier 42 feeds the choke switch, which is not shown, over the resistance 43. The condenser 54 and the parts 55 and 56 are the same as in Fig. 2, but the hand key 53 shown in Fig. 2 is replaced by a swinging lever 81, which is driven mechanically by an eccentric, for instance an eccentrically mounted ball bearing 82, over a change speed gear 83 operated, for instance, by a two pole synchronous motor 84. With each step of the change speed gear one obtains a certain range of welding period. A contact roller 86 is rotated by a further drive, which contact roller closes and interrupts the grid circuit of the auxiliary tube 54 over the battery 87 and the resistance 88. The same serves for the introduction of periods of rest for the welding, as is required in the case of stitch welding, that is to say, great spark distance. If the gear ratio is 1:3 for instance, then the contact is opened only once, when the ignition reaches its apex, but the auxiliary tube 52 is not ignited twice, since the ignition (starting) transformer is short circuited.

Fig. 4 shows how, in the closed time of the charging contact, the charging time t of the condenser 54 and, in the closed time of the discharge contact, the welding time ts determined by the size of the condenser, are distributed. As soon as the condenser voltage reaches a definite value E_c, the negative voltage bias of the battery 60 is preponderant and the rectifier works after the corresponding alternating current wave is terminated.

GERHARD HAGEDORN.

PUBLISHED

MAY 25, 1943.

BY A. P. C.

G. HAGEDORN

METHOD AND APPARATUS FOR ELECTRICAL RESISTANCE WELDING

Filed June 22, 1938

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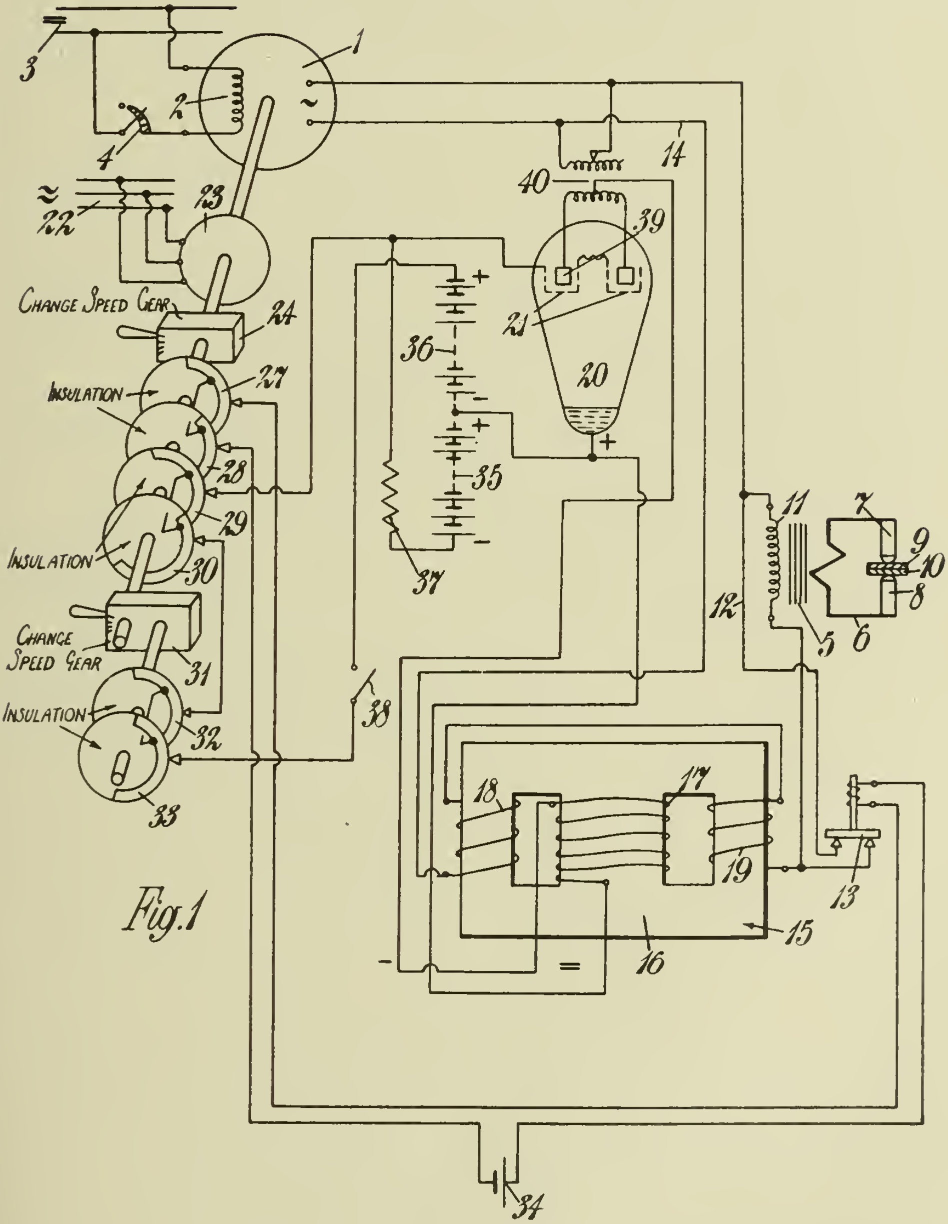

Fig. 1

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3 Sheets-Sheet 2

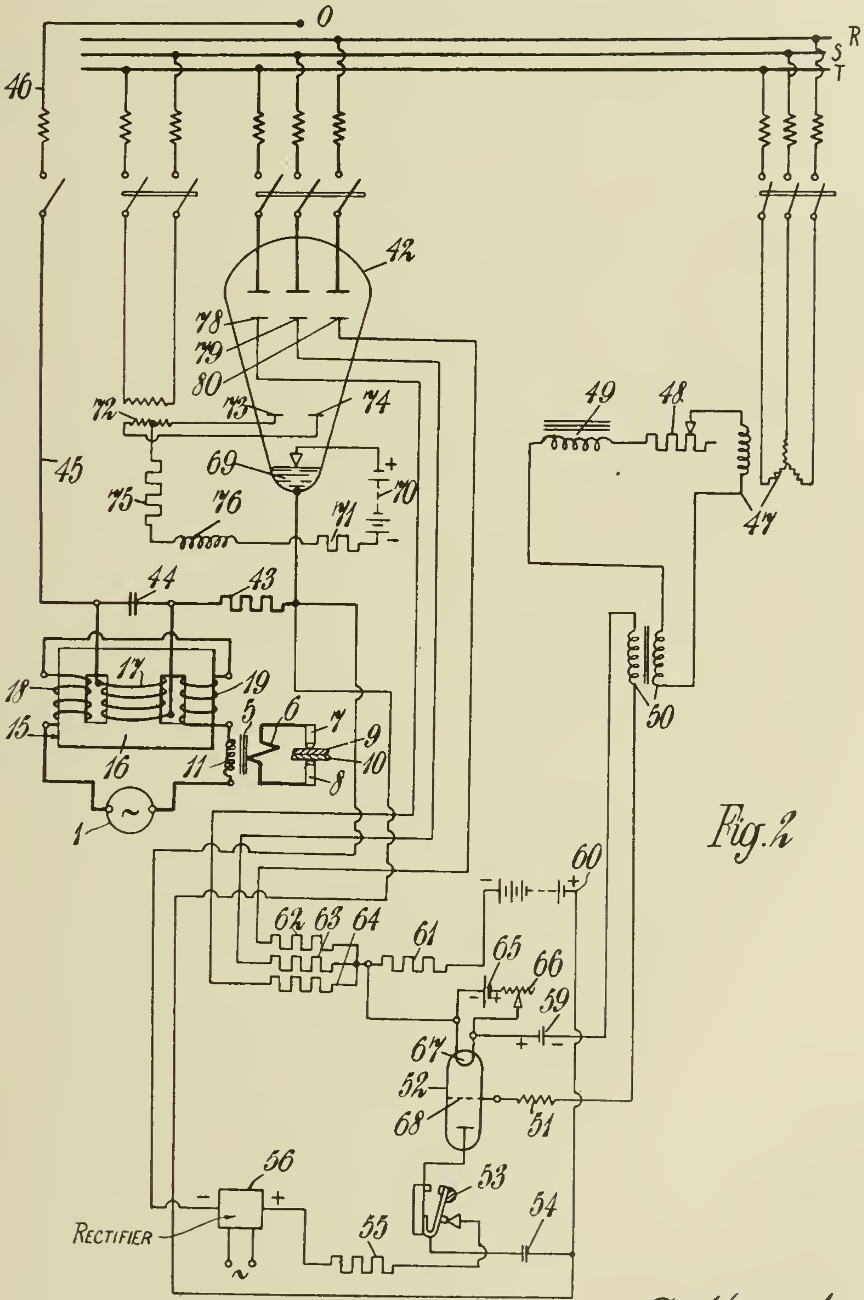

Fig. 2

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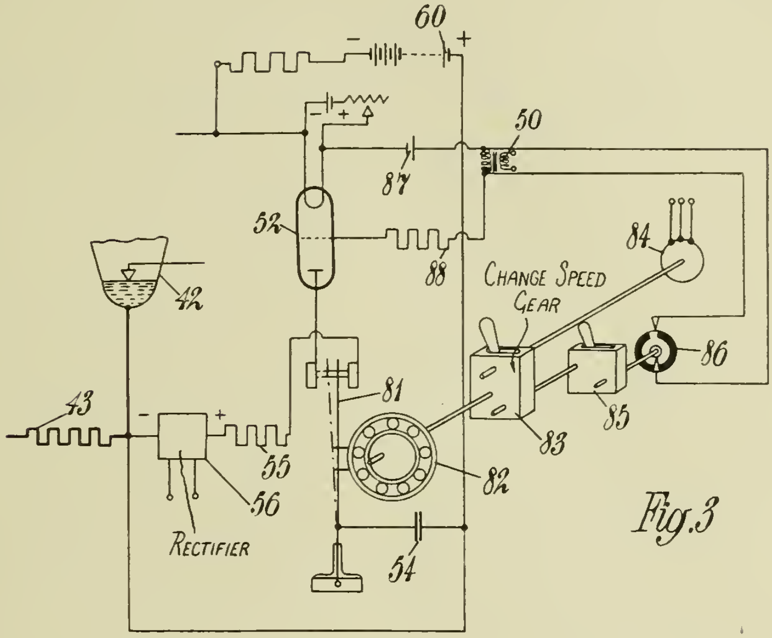

Fig.3

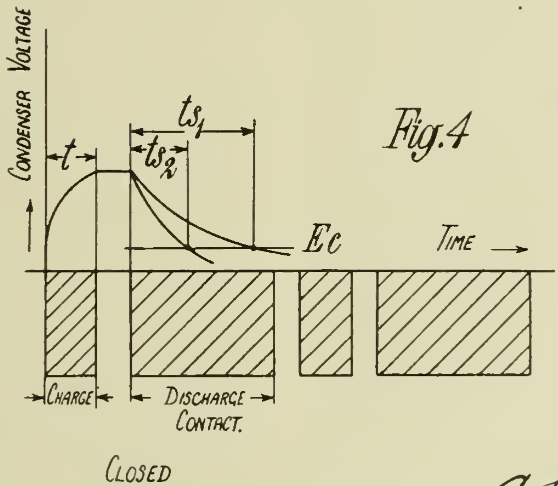

Fig.4

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ALIEN PROPERTY CUSTODIAN

SOFTENING FEED WATER FOR BOILERS

Karl Hermes, Mainz, Germany; vested in the Alien Property Custodian

Application filed June 28, 1938

My invention relates to a process and an apparatus for softening feed water for boilers.

A principal object of the invention is to provide a single apparatus for softening water, in which both steps together, the pre-softening and also the after-softening of the water take place, such apparatus comprising a cascade or a tower apparatus.

A further object of the invention is to provide an apparatus for softening water, which is very economically in its building-up, and which results also in a saving in structural material and in space on the floor of the boiler house, and in the foundation work.

A further object is to provide an apparatus in which the softening proceeds particularly quickly and without friction.

Still another object is to provide a method of softening feed water, in which the flakes composed of the material, which cause the hardness of the water, can be removed without trouble in the usual filters, and in which the water filters extremely well.

Another object of the invention is to provide a method of softening water, in which the water is flowing away from the filter quite clear, and in which no incrustation is formed in the pores of the filtering gravel.

Still further objects will be appearing from the following description:

It is already known to effect the softening of boiler feed water by means of chemicals, in particular chemicals having an alkaline reaction, such as lime, soda, tri-sodium-phosphate or similar materials. Blow-down boiler water which still contained chemicals used for softening, particularly chemicals having an alkaline reaction, has also been employed for softening boiler feed water. It is also known to split up the process of softening boiler feed water into a pre-softening and an after-softening in which case alkaline blow-down boiler water was used for pre-softening and chemicals, such as tri-sodium phosphate for example, were used for the after-softening.

For softening water with the aid of chemicals on the other hand it has, in general, been considered necessary to employ a reaction vessel of large size. As compared therewith, the softening process according to my present invention takes place in a single apparatus, namely in a cascade or tower apparatus, which however is somewhat longer than the towers hitherto used. That the entire softening process could be completed during the passage of the crude water through the cascade or tower apparatus could in no way be foreseen.

Various forms of apparatus for carrying out the new softening process are illustrated diagrammatically and by way of example in the accompanying drawings, in which:

Fig. 1 shows one form of apparatus in longitudinal section,

Fig. 2 is a section on the line II—II of Fig. 1,

Fig. 3 is a section through another form of a cascade or tower apparatus also on the line II—II of Fig. 1, and

Figs. 4 and 5 are further constructional forms of the new softening apparatus.

Referring to the drawings, the cascade or tower apparatus 1 is provided in the usual manner with intermediate plates 2 which are either arranged horizontally as shown in Fig. 2 or are disposed obliquely relatively to one another as shown in Fig. 3. The crude water enters the tower through the inlet 3 and meets the blow-down boiler water which is introduced through the inlet 4. The gases evolved escape through the pipe 5. When the crude water and the blow-down boiler water mix, a pre-softening of the crude water is effected in accordance with the amount of the chemicals contained in the blow-down boiler water. To the water which has been pre-softened in this manner a solution of softening chemicals is supplied through the inlet 6. In the case of the apparatus with inclined plates shown in Fig. 3, where the water runs down over one edge of the plate, the supply of chemicals is preferably effected at this place where the water mostly collects since the mixing is then most intensive.

For the after-softening, tri-sodium-phosphate is preferably employed since this eliminates from the water any carbonates causing hardness and converts them into the form of calcium or magnesium phosphate and simultaneously forms soda which in turn act as pre-softening agents on the return of the boiler water so that one and the same chemical is, as it were, used twice for the softening. Instead of tri-sodium-phosphate other known softening agents can also be employed such as aluminates, soda, caustic soda, or combinations thereof.

The distance apart of the inlets for the crude water, the blow-down boiler water and chemical solution depends of course on the desired capacity of the softening installation and also on the quality of the water and on the softening agents employed. An intermediate chamber with one plate between each two stages may even be sufficient in some cases.

If the heat of the blow-down boiler water is not sufficient for producing the temperature required in the cascade or tower apparatus, steam can be blown in through the inlet 7 at the lower end of the tower. The temperature can be controlled, if desired, by means of a thermostat 14 which is preferably arranged between the inlet 3 for the crude water and the inlet 4 for the blow-down boiler water; then when the temperature falls the inlet for the supply of steam or boiler water is opened to a greater extent by the thermostat 14 and when the temperature rises the supply of steam or boiler water is reduced.

The water which has been softened in this manner arrives in the filter in which it flows through the filtering gravel 9 where the flakes of the materials which caused the hardness are retained. The water leaves the apparatus through the outlet 10 in a clear condition ready for use.

The usual back-flushing device 11 which consists of a tube provided with holes is fitted in the filter. The flushing water leaves the filter through the outlet 12, which, however, remains closed during the softening and filtering operation. Finally an over-flow pipe 13 is provided which indicates when any blocking or stoppage of the filter occurs. Obviously any other suitable kind of filter could be employed.

In normal operation the resistance of the filter of course increases gradually owing to the flakes of the materials, which cause the hardness, being deposited therein. Consequently the depth of the layer of water above the gravel continuously increases which in turn results in a continuous increase in the water pressure. In order now to prevent a return flow of the water above the gravel, it is preferable to connect the lower part of the cascade or tower apparatus to the filter by a pipe 15 as shown in Fig. 4. This pipe is advantageously made as wide as possible, for example as shown in the drawing, as large as the cross-section of the tower since a separate frame for supporting the tower is then unnecessary.

Fig. 5 illustrates a form of apparatus in which the tower is not in communcation with the atmosphere but operates under an excess pressure. This may be the case for example when the apparatus is to be employed on board ship. Consequently there is provided in the outlet 5 of the tower a valve 16 through which any gases which collect in the tower, such as carbon dioxide, oxygen and any excess steam, are blown-off when a predetermined pressure is reached. In addition the apparatus shown in this figure also enables the tower and the filter to be separated the one from the other, for example to be disposed in different compartments or on different decks, in which case the pipe 15 which connects them is of suitable shape and length.

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SOFTENING FEED WATER FOR BOILERS
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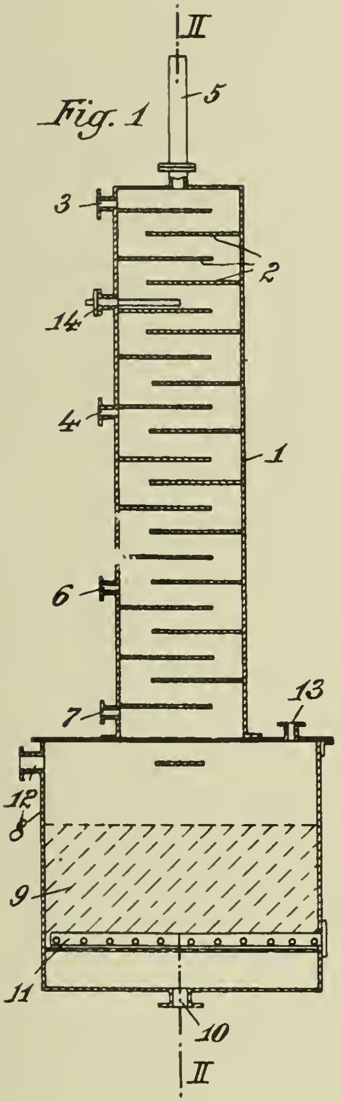
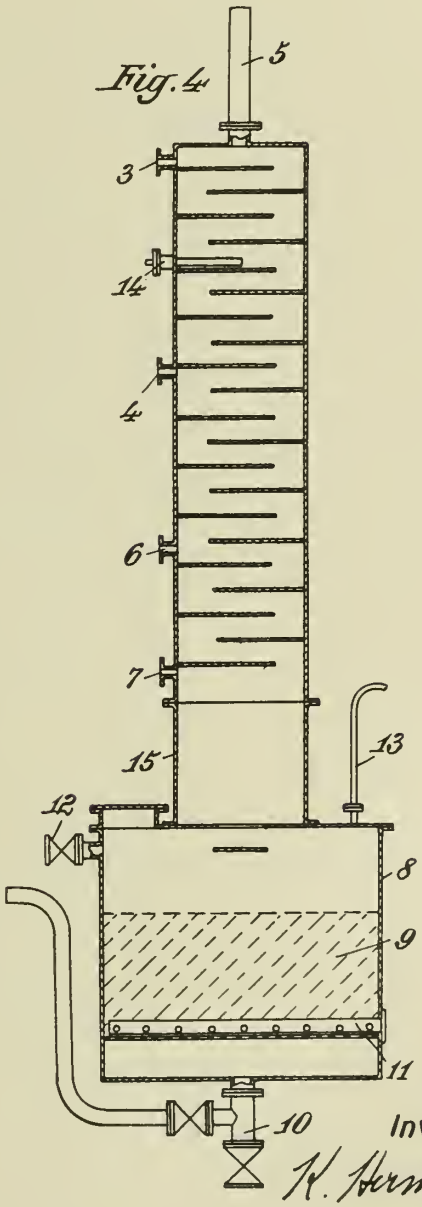
2 Sheets-Sheet 1





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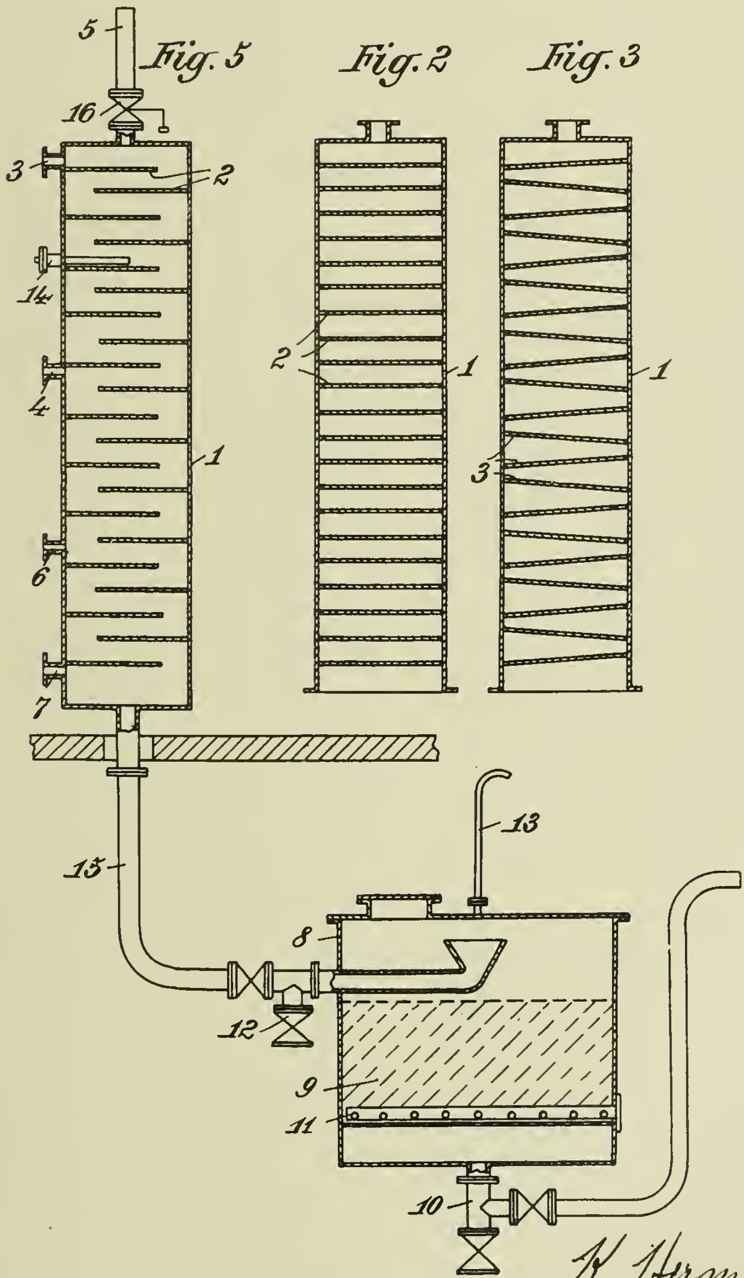

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ALIEN PROPERTY CUSTODIAN

TOTAL-TAKING MECHANISM

Robert Anschutz and Fritz Schmidt, Zella-Mehlis, Thuringia, Germany; vested in the Alien Property Custodian

Application filed July 13, 1938

This invention relates to a total-taking mechanism for the automatic clear writing of column and cross totalisers by decimal places.

Such mechanisms have already become known but have the drawback that it is difficult to equip a machine for cross total taking which is constructed for vertical total taking only.

According to the invention, these drawbacks are eliminated as follows:

A manually operated controlling member for the cross totalisers, and a manually operated controlling member for the column totalisers, connect, through a universal member, a driving member which performs the total-taking operation, to a source of power, and locking members holding the controlling members in their active position are arranged to be moved into their active position with respect to a universal part which is preferably influenced by the movement of the paper carriage, when the controlling members are moved into such active position.

By providing the universal elements aforesaid, disassembling is facilitated.

In the drawings a contructional example of the invention is illustrated.

Fig. 1 is a front elevation of a typewriting-calculating machine equipped with the mechanism according to the invention, the paper carriage being omitted and only its suspension rail, with the column totalisers, being shown.

Fig. 1*a* is a partial view according to Fig. 1, on an enlarged scale, to give a better representation of the members arranged in this part of the machine.

Fig. 1*b* is a diagram of the cross totaliser unit illustrated in Fig. 1.

Fig. 2 is a portion of Fig. 1, showing a somewhat modified construction.

Fig. 3 is a plan view of Fig. 1, showing only the front portion of the machine, with the column and cross totalisers omitted.

Fig. 4 is a plan view of Fig. 2 in which the column and cross totalisers are also omitted.

Fig. 5 is a section through the calculating mechanism on the line *a*—*a* in Fig. 4, viewed in the direction of the arrow *c*, in which the column and cross totalisers are shown but other parts which are less important for the explanation of the invention, have been omitted.

Fig. 6 is a section through the calculating mechanism on the line *b*—*b* in Fig. 4, viewed in the direction of the arrow *c*, in which the column and cross totalisers are shown, and other parts omitted.

Fig. 7 is a perspective illustration showing control parts in the calculating mechanism which effect the automatic total taking from the column and cross totalisers, several parts being shown remote from each other for the sake of clearness.

Fig. 8 is a perspective illustration of parts which effect the total taking from the cross totalisers, parts being shown remote from each other.

Fig. 9 is a perspective illustration showing the parts illustrated in Fig. 8, as modified for the machine illustrated in Figs. 2 and 4.

Fig. 10 is a perspective illustration showing other parts effecting the total taking from the column and cross totalisers, viewed from the left and the front of the machine.

Fig. 11 is a front elevation of one of the column totalisers.

Fig. 12 is a perspective view supplementing Fig. 10 and showing the controlling member for the column totalisers, and other parts cooperating with the member, also viewed from the left and the front of the machine.

Fig. 13 is another perspective view supplementing Fig. 12, also viewed from the left and the front of the machine, and corresponding to Fig. 8 of Patent — — (patent application Serial No. 146,897).

Fig. 14 is a side elevation of the principal parts in Fig. 13.

Fig. 15 is a front elevation of the parts shown in Fig. 13.

Fig. 16 shows diagrammatically a portion of a form filled in with items to be booked by the machine.

Fig. 17 shows a portion of another form to be booked by the modification illustrated in Figs. 2 and 4.

General description of the machine

The principal parts of the machine are the frame **1** (Figs. 1 and 2) which supports the typewriting mechanism, and the paper carriage, not shown. On the suspension rail **8** which is secured to the paper carriage, the column totalisers **2** to **5** and the idle totalisers **6** and **7** (Figs. 1, 1*a*, 2, 5, and 6) are arranged. A wall **9** (Figs. 1 to 6) which supports a calculating mechanism, is arranged behind the keyboards of the machine. A slotted table **10** is arranged at the right-hand side of the machine, and secured by suitable means. A slide **11** is mounted to reciprocate longitudinally in the slot of the table. On this slide **11**, the cross totalisers **12** and **13** are adjustably secured. The cross totalisers **12** and **13** are

moved by that column totaliser which is in active position at the time, by links 14, 15.

Mounted in the machine frame 1 (Figs. 1 and 3) are the keys 16 of a typewriting keyboard, with tabulator keys 17, and a carriage frame return key 18. A bearing frame 19 (Fig. 1) forms a further part of the machine, in which frame are mounted a calculating keyboard 20, a set of decimal tabulator keys 21, a column total taking key 22 (Figs. 1, 3 and 7), a cross total taking key 23 for the cross totalisers (Figs. 1, 3, and 10). A motor 24 secured to the right-hand side of the machine frame operates, through suitable gearing, the drive of the calculating camplate elements, not shown, of the typewriting mechanism, not shown either, and of the carriage return.

The normal calculating and typewriting operations for the entries required in columns I to IV of the form Fig. 16

For this operation, the column totalisers 2 to 7 are adjusted on the suspension rail 8 in positions corresponding to the columns I to VI of form 25 (Fig. 16). The tabulator riders allotted to the column totalisers but not shown are adjusted on the known rider bar.

At the same time, the cross totalisers 12 and 13 are put on the slide 11 in the required positions with respect to the column totalisers, or their driving gears, adjusted, and secured. The adjusting and securing operations, however, are not performed by screwing to the slide 11, but in the way which is usual already for the cross totalisers by the cooperation of a clip 28 which is swingable around a pivot 27 under the influence of a spring 26 (Fig. 5), with a prismatic bar 29 secured to the slide 11. The clip 28 is moved out of clamping position with respect to the prismatic bar in the usual manner by a handle 30 while the clip can be held in clamping position with respect to the cross totaliser after the cross totaliser has been placed in position, by a locking member 31 placed before the handle 30. A nose 32 formed at the handle 30 engages, in the clamping position of the clip 28, in that gap in a rack 33 secured on the slide 11 (Fig. 5) which is just opposite the nose, and thereby the cross totaliser, or cross totalisers, are held in their positions, as adjusted. For this purpose, the pitch of the rack is, as usually, selected in conformity with the steps of the carriage feed.

The cross totalisers 12 and 13 make up together a complementary totaliser or unit K (Fig. 1*a*), as will be explained more fully below. To this end, the sequence of the numbers on the number rollers of the cross totaliser 12 is the reverse of that on the rollers of the cross totaliser 13. The cross totaliser 12 at the left is positive, and the totaliser at the right is negative. In consequence thereof, a total is taken by subtraction in the positive totaliser 12, and a total indicated in positive form is to be taken by addition in the negative totaliser 13.

The form 25 is placed on the platen in conformity with the position of the column totalisers 2 to 7, and placed in typewriting position with its first line. Thereupon, the paper carriage is moved into its final position at the right, for instance, by depressing the carriage return key 18.

In the booking example which will be described, the items of the same kind to be entered in the columns I and III of the form 25 which are indicated and added in the column totalisers 2 and 4, are calculated in positive form in the cross totaliser 12, and the corresponding complementary value appears in the cross totaliser 13. The values to be written down in the column II and IV of the form are transferred transversely in the opposite sense as before, i. e., subtractively, into the complementary unit K comprising the cross totalisers 12 and 13. At the same time, the items in column II and IV appear in positive form in the column totalisers 4 and 5. Due to the fact that the credit items in columns II and IV are introduced in opposite direction to the debit items in columns I and III, the balance is found which may appear on the debit or credit side, i. e., in the column V or VI of the form 25, in conformity with the ratio of the debit and credit items. That cross totaliser in which the balance then appears, is thereupon placed in cooperative position to the corresponding idle totaliser 6 or 7, in a manner to be described more fully, by operating that decimal tabulator key 21 which corresponds to the amount of this balance, whereupon the automatic clear writing of the corresponding cross totaliser 12 or 13 forming part of the complementary totaliser unit K can be begun. The balance is now written down in the column V or VI of the form.

In order to effect the bookings in the columns I to IV of the form 25, for example, in its first line, it is necessary to move the paper carriage with respect to the totalisers 2 to 5, or the columns I to IV, into the operative position required at the time. This is effected by depressing the tabulator key 21 corresponding to the item to be booked. During the thereupon occurring movement of the carriage to the left, and therewith of the totalisers 2 to 7, the cross totalizers 12 and 13 which make up the complementary totaliser unit K, are automatically coupled to a dog 33*a* (Fig. 1) of that cross totaliser 2 to 7 which moves into active position at the time, by means of the links 14, 15 (Fig. 3) of the slide 11 (Figs. 1 to 6) which carries the two cross totalizers 12 and 13, so that these partake in the movement to the left. In this operation the cross totalisers 12 and 13 are each time moved into driving connection with driving gears 35 and 36 which are mounted to turn on a driving shaft 34 (Figs. 1 and 3 to 7) but are held against axial displacement. That column or idle totaliser which is thereby moved into calculating position, comes into driving connection with a driving gear 38 coordinated to all totalisers (Figs. 3, 4, and 7) and secured on another driving shaft 37. When the paper carriage, or the totalisers 2 to 7, and the cross totalisers 12 and 13, move into active position, each totaliser, through controlling plates 39, 40 and 41, secured to the totaliser as required, acts on controlling levers 42 (Fig. 4), 43, (Fig. 9), and 44. Thereby, in a manner to be described more in detail in connection with the total taking operation, the calculating mechanism is unlocked and the species in the cross totalisers is selected. The controlling lever 44 serves for the alternately moving into engagement of coupling teeth 111 and 112 of a coupling sleeve 45 mounted to slide axially on the driving shaft 45, with coupling teeth 46 and 47 of the driving gears 35 and 36 which are also arranged on the shaft 34. A link 102 pivotally connecting the controlling lever 44 to a coupling arm 103 (Figs. 4 and 9) serves for transmitting the movement imparted to the controlling lever 44 from the totalisers 2 to 7, to the coupling sleeve 45. In the case of the present booking operation, the teeth 111 and 112 of the coupling sleeve

45 must be engaged with the driving gears 35 and 36 at the same time, and therefore the link 102 is removed and the controlling lever 44 is rendered inactive. The coupling arm 103 which controls the sleeve 45, and is fulcrumed about a screw 108 in the casing of the calculating mechanism, is held in neutral position by a screw M inserted in a hole of its extension 103*a* and secured in a bracket L (Fig. 7) on the casing of the calculating mechanism.

Before a tabulator key is depressed for releasing the carriage so that it moves to the left, as described, the species of calculation to be performed in the column totalisers 2 to 5 is selected by means of knob 48 (Figs. 1 to 4). Usually, the species is addition, and so the knob 48 is turned so that its index 116 (Fig. 1) is on the mark "A" in the front wall 81 of the calculating mechanism. A tilting member 117 (Fig. 7) is positively connected to the knob 48 and transmits the movement of the knob to a rod 120 through a pin 118 engaging in a notch 119 in the rod. The rod is connected to parts 121 to 127, an arm 122 being equipped with a pin 121 at its upper end, and a slot 285 in the rod 120 engaging over the pin. A spring 123 attached to the arm 122 effects a connection which is positive in one direction, and yielding in the other.

When the knob 48 is turned as described, an intermediate spur gear 127 is moved into the position illustrated in Fig. 7, as follows: The spur gear 127 is connected to a shaft 50 by claws 130 and a clutch disk 131 secured on the shaft, so that it can be displaced on the shaft but is held against rotation with respect thereto, and, in position illustrated in Fig. 7, the totaliser driving gear 38 is rotated through the driving shaft 37 to which rotation is imparted by a train of gears 127, 132, 133, and 134, and this rotation corresponds to addition.

For accounting and writing the items to be booked in columns I to IV, the corresponding calculating keys 20 are depressed, and the value introduced are transferred to that column totaliser 2 to 5 which is in calculating position at the time, through the medium of a spur gear 49 on the shaft 50 (Figs. 1, 1*a*, 3, and 4), and through the driving gear 38 on the shaft 37, in conformity with the position of the species knob 48. The operative connection of the shafts 50 and 37 is effected by a change-speed gear, as will be described below with reference to total taking.

The mechanism for automatic total taking

The balances calculated from columns I to IV of the form 25 (Fig. 16) in the cross totalisers 12 and 13 which make up the complementary unit K (Fig. 1*a*) will now be withdrawn by automatic total taking and typewritten in the columns V and VI of the form 25. Let it be assumed that first the item "125" in the cross totaliser 12 is withdrawn and written in the first line of column V of the form 25. At the same time, the cross totaliser 13 which indicates the complementary value 9999 875, must be automatically returned to zero. The complementary value must obviously not be written on the form.

In order that the cross totaliser 12 can be written clear, the idle totaliser 6 must be moved into the corresponding active position, since it controls the cross totaliser 12. This is effected by depressing the "100" tabulator 21. The movement of the carriage to the left which is started thereby, is limited by the tabulator rider (not shown) which is co-ordinated to the idle totaliser 6, engaging the column selector lever (not shown) co-ordinated to the depressed tabulator key. In this position, the cross totalisers 12 and 13 which have been moved by the dog 33*a* of the idle totaliser 6 (Fig. 1) and the links 14, 15, are engaged by the driving gears 35 and 36 (Figs. 3 and 7) with their 100 places.

The control plates 41 (Figs. 5, 6, and 11) of the column totalisers 2 to 7 serve for the selection of the species. The plate 41 is mounted to slide at the inner side of a front plate 51 of each totaliser 2 to 7 and arranged to occupy three distinct positions. A rib 52 projecting inwardly from the front plate 51 (Figs. 5 and 11) engages in one of three grooves 53 in the cam plate 41. For the purpose of adjusting the plate 41, a clamping screw 54, with a knurled handle 55, (Fig. 5) extends through a slot 56 in the front plate 51 (Fig. 11). The position of the control plate 41 is indicated by a mark 57 on the plate, and marks 59 at both sides of a hole 58 in the front plate 51. The three positions of the plate are: Addition, marked "A", release, marked "E", and subtraction, marked "S."

Since in the present example the value indicated in the cross totaliser 12 is additive, it must be withdrawn by subtraction. Therefore, the control plate 41 of the idle totaliser 6 is adjusted for subtraction, "S." When the paper carriage returns, the control plate 41 of this idle totaliser 6 engages the lever 43 (Figs. 3 and 7) which is a bellcrank. The control plate 41 turns the bellcrank 43 clockwise about its fulcrum 51 against the action of a spring 60 (Figs. 1 and 7) and a pin 62 at the lower end of the bellcrank engages a tilting member 63 and a rod 64. The rod 64 is pivoted to a rocker 65 on a shaft 66, and the bellcrank 43, through the means described, turns the rocker anti-clockwise, and its movement is transmitted to a spur gear 65 by a slide 67, as follows: A pin 69 on the rocker 65 engages in a slot 70 of the slide, and a tooth 71 on the slide engages in a groove of the spur gear 68. The spur gear is mounted to slide on the shaft 50 and is held against rotation about the shaft by bars 72 engaging in grooves in the perimeter of a disk 73 which is keyed on the shaft.

When the spur gear 68 is shifted by the mechanism connected to the rocker—which turns anti-clockwise, as described,—it moves out of mesh with a pinion 74 on the shaft 34 and into mesh with a lay pinion 75 which is mounted to rotate in the casing of the calculating mechanism and meshes with a driving spur gear 76 secured on shaft 34.

The drive which for addition is from the shaft 60 to the shaft 34 through spur gear 68, pinion 74, and shaft 34, is now reversed for subtraction, since the shaft 50 now drives the shaft 34 through the spur gear 68, the lay pinion 75, and the spur gear 76.

One end of a rod 77 is pivoted to the lower end of the bellcrank 43 and slides on headed screw 80 at the front wall 81 (Figs. 5 and 6). The rod 77 is shifted by the swinging motion of bellcrank 43 in the direction of the arrow C. The lower end 82 of a downwardly extending arm 83 of rod 77 is connected to a selector lever 86 by means of a headed rivet 87 in a crooked portion 85 of the selector lever projecting into a slot 84 in the lower end 82. The selector lever 86 is mounted to swing and to be shifted upwardly by means of a slot 88 and a headed screw 90 extending through the slot. The screw 90 is secured in a bracket 89 and this is attached to a

part 92 of the casing for the calculating mechanism by screws 91 (Fig. 1). In its initial position, the selector lever 86 is supported by gravity, the upper end of its slot 88 resting on the headed screw 90. With a plate 93 at an arm 94 extending to the right, the selector lever 86 can be moved into active position with respect to two bellcranks 95, 96 (Figs. 1*a* and 8), as will be described below. The selector lever 86 in its lower end has a crooked lug 97 provided with a U-shaped hole 98. A headed screw 99 secured in the machine frame (Fig. 1) projects through the hole 98 whereby the selector lever is further guided. When the rod 77 is shifted as described, the selector lever 86 is swung clockwise about the bearing screw 90 by the pin-and-slot connection 87, 84. The selector lever 86 now moves into active position to a lug 100 (Figs. 1*a*, 8) of the bellcrank 95 with the plate 93 of its arm 94. The lug 97 of the selector lever 86 now moves into reach of the guiding screw 99 with the shank 101 of the U-shaped hole 98.

Since, as described in the paragraph "the normal calculating and typewriting operations . . ." etc., both driving gears 35 and 36 are driven together for the booking operation described, the control plate 40 which operates the sleeve 45 (Figs. 5 and 6) is not required in the idle totaliser 6 and is dispensed with, as well as the lever 44 and the link 102 illustrated in Fig. 9 and omitted in Fig. 7. When the idle totaliser 6 has moved into calculating position, its control plate 39 acts on the control lever 42 (Figs. 3 and 5) and releases a locking mechanism 113, 114, 115, and thereby the totaliser.

Preparation of the total taking operation upon depression of the controlling members for the cross totalisers

A bar 135 is secured in the bearing frame 19 at the right hand side of the machine (Fig. 10) and a controlling member 136 for the cross totalisers 12 and 13 is mounted to swing about the bar and held against axial displacement. The cross total taking key 23 for manual operation is secured to the front end of the controlling member 136. The bar 135 is secured to the bearing frame 19 in similar manner. A stepped extension projects from the lower side of the controlling member 136 at 138 for holding the member in its initial position and a spring 137 pulls the extension 138 against the rear side of a locking bar 139 which is also secured in the bearing frame 19.

A locking member 140 is fulcrumed on the controlling member 136 at the left about a screw 552 which prevents lateral displacement of the locking member. A spring 141 connecting the members 136 and 140 pulls a tongue 142 against the other side of the locking bar 139 and holds the locking member 140 in its initial position.

The tail end of the controlling member is crooked twice, at 143 and at 144, and the crook 143 engages the lower end of the lever 86 when the member is depressed. At the same time, the tail end 145 of the locking member 140 engages below a lug 146 at the top of the tail end 147 of a crooked lever 148 from which the end 147 projects in upward direction. The lever 148 is fulcrumed on a transverse bridge 150 by a headed screw 149, and its inner end is equipped with a pin 151 engaging in a slot 152 at the inner end of a lever 153 which is fulcrumed on the bridge 150 by headed screw 154. The tail end 156 of the lever 153 is crooked upwards and equipped with a lug 155 at its upper end for cooperation with parts to be described below. The bridge 150 has a lug 157 at one end which is secured to a bracket 160 in the bearing frame 19 by screws 158 (Fig. 1) and its other end is secured to the locking bar 139 by a pair of tongues 161 (Fig. 10) and screws 162.

When the controlling member 136 is depressed the tongue 142 of the locking member 140 engages in a groove 163 in the locking bar 139 under the action of the spring 141, holding the locking member 140 and the controlling member 136 in depressed position. When the controlling member 136 is depressed, a shoulder 164 on the member engages a pin 167 riveted into a bent-over lug 165 at one end of a lever 166. The lever 166 which is fulcrumed on the inner side of the front traverse bar of the bearing frame 19, about a headed screw 168 (Figs. 1 and 10), is operatively connected to another lever 171 (Figs. 1, 10, and 12). This lever which is also fulcrumed on the inner side of the front traverse bar of the bearing frame 19 about a headed screw 172, can act on a plate 174 of a lever 175 with a bent lug 173. The lever, or universal member, 175 is arranged at the left-hand side of the controlling member 176 (Fig. 12) for the total taking from the column totalisers 2 to 5 on the bar 135. By a spring 177, the universal member 175 is permanently urged anti-clockwise about the bar 135, and the tail end 175*a* of the universal member 175 cooperates with a clutching arm 178 whereby the camplate element, here designated 501, 502 is held disengaged from a permanently rotating shaft 504. The total taking controlling member 176 (Fig. 12) for the total taking from the column totalisers 2 to 5 is different in so far, as it cannot act directly on the clutching arm 178 with its tail end, but only through the universal member 175, for which purpose the member has a lug 179 acting on the plate 174 of the universal member 175. However, the tail end of the controlling member 176 can act on a slide 180 which has been shown only partly and on a lever 282, Fig. 12, as will be described.

When the key plate 23 (Fig. 10) for the cross totalisers is depressed, the controlling member 136 is swung about the bar 135 clockwise against the action of its spring 137, and the locking member 140 is moved in the same direction by the spring 141. The tongue 142 of the locking member 140 slides off the locking bar 139 and then, at the end of the swinging movement, engages in the groove 163 of the locking bar 139 under the pull of spring 141. By these means, the controlling and locking members 136 and 140 are held in their swung-out positions.

During the swinging of the members, the tail end 145 of the locking member moves into active position with respect to the lug 146 on the lever 148 by which it is influenced toward the close of the total taking operation, as will be described. The crooked tail end 143 of the depressed controlling member 136 bears against the lower end of the lever 86 which, as described, has already been turned clockwise, and raises it. The plate 93 (Figs. 7 and 8) at the upper end of the lever 86 now engages the lug 100 of the bellcrank 95 and the bellcrank together with mechanism under its control, are operated as will be described. If, however, the control plate 41 in one of the column totalisers 2 to 5 has been shifted to "E," and this totaliser is in calculating position, the edge 650 (Figs. 1, 2, 7, and 9) of the hole 98 in the lug 97 of the lever 86 engages the head of screw 99 and

prevents further depression of the controlling member 136.

At the same time, the shoulder 164 on the depression controlling member 136 engages the pin 167 at the outer end of the lever 166. The lever is swung clockwise about its screw 168. The lever 171 is swung anticlockwise about its screw 172 and its lug 173 engages the plate 174 at the front end of the universal member 175. The universal member is now swung about the bar 135 clockwise against the spring 177, and its tail end 175*a* moves clear of the clutching arm 178. The arm is now operated and the camplate unit 501, 502 is coupled with the clutch gear T (Fig. 12) and the shaft 504 which is permanently rotated from the motor 24.

The zero stop mechanism for the cross totaliser 12

The bellcrank 95 (Figs. 1*a* and 8) is fulcrumed on the casing of the calculating mechanism by a headed screw at 181. A rod 182 is pivoted to the upper arm of the bellcrank by a rivet 183 at one end, its other end being connected to a screw 184 on a lever 185. The lever 185 is fulcrumed on the rear wall of the calculating mechanism casing about a screw 186 and its forked upper end 187 engages a pin 188 on a slide 189. The slide is slotted at 190 and a screw 191 in the rear wall engages in the slot for guiding the slide which is supported by a pin 192 in the rear wall. A spring 193 turns the lever 185 about its screw 186 in anti-clockwise direction and the lever moves the slide 189 to the left. This movement is limited by the end of the slot 190 bearing against the screw 191 and defining the initial position of the corresponding parts.

A flap 195 is mounted to turn about a shaft 194 but held against axial displacement and its tail end 196 is engaged by the inner end 197 of the slide 189. A spring 198 holds the tail 196 against the end of the slide 189 and, in turn, pushes the slide against its supporting pin 192. The shaft 194 is supported by a bracket 197*a* (Fig. 1*a*) which is secured to the front wall 81 of the calculating mechanism by screws 198*a*. The flap is held against lateral displacement on the shaft 194 between a flange 199 of the bracket 197 and an annular check 200 on the shaft 194. A zero stop 203 is secured on an upwardly directed portion 201 of the flap 195 by screws 202 which acts on parts of the cross totaliser 12 in a manner to be described below.

A lever 205 (Figs. 6 and 8) is keyed on a shaft 204 arranged suitably in the calculating mechanism by its boss 206. A push rod 207 is pivotally connected to the free end of the lever 205 by a screw 208. The free end 209 of the push rod is reduced and engages below the slide 189. An inclined face 210 is formed on the push rod for cooperation with the slide 189, for a purpose which will be described. The end 209 is guided in, and supported by, a recess in the rear wall of the calculating mechanism. An inclined face 211 on the slide 189 cooperates with the tail end 196 of the flap 195 for a purpose to be described below.

The zero stop mechanism for the totaliser 13

A bellcrank 96 which is similar to the bellcrank 95, is fulcrumed about the same headed screw 181 (Fig. 8) in the calculating mechanism. At the upwardly projected arm of the bellcrank lever 96 is pivoted a rod 213 by a headed rivet 212 and the other end of the rod is pivoted to a lever 215 by a headed screw 214. The lever 215 which is fulcrumed on a headed screw 216 in the rear wall of the calculating mechanism embraces a pin 218 on a slide 219 with its upper forked end, 217. The slide 219 is mounted for longitudinal displacement along the rear wall of the calculating mechanism by a slot 220 and a screw 221 secured in the rear wall. It is further guided by a pin 222 secured in the rear wall. A spring 223 engaging the lever 215 swings the lever 215 permanently against clockwise rotation about its fulcrum screw 216, and the lever pushes the slide 219 to the left. These movements are limited by the end of the slot 222 bearing against the screw 221 in which position the parts mentioned and the members connected to them are in their initial positions. Another flap 224 is mounted to swing about, but held against axial displacement on, the shaft 194 and its tail end 225 is in one-sided operative connection with a nose 226 of the slide 219. A spring 227 engaging the tail end 225 of the flap 224 holds the tail end permanently against the nose 226 of the slide 219 and by these means the slide 219 is permanently held against the supporting pin 222. Between a flange 228 (Fig. 1*a*) of the bracket 197*a* and an annular check 229 secured on the shaft 194, the flap 224 is held against lateral displacement on the shaft 194. A zero stop 232 is secured on an upwardly extending front portion of the flap 224 by screws 231, which stop can act on parts of the mechanism of the cross totaliser 13, as will be described. A lever 233 is secured with its boss 234 on the shaft 204 which has been described in the paragraph "The zero stop mechanism for the cross totaliser 12." A push rod 236 is pivotally connected to the free end of the lever 233 by a screw 235. The free end 237 of the push rod is reduced and engages below the slide 219. An inclined face 238 is formed on the push rod 236 for cooperation with the slide 219, for a purpose which will be described. The push rod 236 is guided in, and supported by, a recess in the rear wall of the calculating mechanism. An inclined face 239 on the slide 219 cooperates with the tail end 225 of the flap 224 for a purpose to be described below.

The shaft 204 on which are mounted the usual unlocking levers 240 (Figs. 5 and 6) for the unlocking of the cross totalisers 12 and 13 is operatively connected to the unlocking shaft 115 by levers 241 and 243 and a pin-and-slot connection 242. The calculating mechanism unlocking lever 244 for the column totalisers is keyed on the shaft 115.

Operation upon depression of the cross total taking key plate 23

When the cross total taking key plate 23 (Figs. 3 and 10) is depressed as described, the locking member 140 which is coordinated to the controlling member 136, raises the lug 155 at the tail end of the lever 153 through the medium of its own tail end 145 and the parts 146, 147, 148, 151, and 152, and the lug bears slightly against a tooth 250*a* (Figs. 10 and 12) at the lower end of a universal part 250, this being a forked rod suspended from one end of an arm 251 whose other end is fulcrumed about a screw 252 in the rear wall of the calculating mechanism. A pawl 253 is pivoted on the arm 251 about a screw 254. The operation of the pawl will be described below. A spring 255 is connected to the pawl 253 at one end and secured in an eye of the arm

251 at its other end, pulling the pawl against a check B on the arm 251.

As mentioned, the controlling member 136 for cross total taking operates the selector lever 86 which in turn operates the bellcrank 95 (Fig. 8). The bellcrank is pivotally connected to the rod 182 and so turns the lever 185 in the same direction and the slide 189 is shifted in the direction of the arrow *n* until the left-hand end of its slot 190 is arrested by the screw 191. During this movement, the inclined face 211 of the slide moves below the tail end 196 of the flap 195 and turns the flap clockwise. By these means the zero stop 203 is moved into slight engagement with the zero setting wheel 125 (Figs. 5 and 6) of the cross totalizer 12 at its 100 place which has previously been moved into writing and calculating position.

While these operations are performed the cross total taking controlling member 136 (Fig. 10) engages the pin 167 of the lever 166 with its shoulder 164, turning the lever clockwise. The lever 166, through the pin-and-slot connection 169, 170 (Fig. 12), turns the lever 171 in opposite direction and its lug 173 engages the plate 174 of the universal member 175. The universal member is now turned clockwise but does not influence the column total taking controlling member 176. The tail end 175*a* of the universal member now moves away from the clutching arm 178 of the camplate unit 501, 502. The arm now turns under the action of its spring 503 (Fig. 12) and so its tooth 178*a* engages between the teeth of the driving wheel T. This wheel is rigidly connected to the driving shaft 504 while the camplates 501 and 502 are rigidly connected to each other but are free to turn on the shaft 504.

The camplates now rotate with the driving shaft 504. The camplate 502 controls an unlocking slide 506 (Figs. 12, 13, 14, and 15) whose lower end supports a roller 507. Springs 508 and 509 (Figs. 12 to 15) hold the roller against the edge of the camplate 502. As the elevated portion of the camplate 502 recedes, the unlocking slide descends. An inclined edge 510 on the slide 506 engages a catch 511 of an arm 512 which is free to turn on the unlocking shaft 115 (Figs. 5, 13, and 14), turning the arm clockwise. The arm 512 engages a lug 513 of an arm 514 which is keyed on the shaft 115 and the shaft is turned, unlocking the calculating mechanism. The turning movement of the unlocking shaft 115 is transmitted to the unlocking levers 240 through the parts 243, 242, 241 and the shaft 204. The cross totaliser 12 is now unlocked through a member 516 and the cross totaliser 13 is unlocked by another finger.

The shaft 204 which turns in the direction of the arrow *p* (Figs. 5 and 8) when the cross totalisers are unlocked, moves the push rod 207 to the rear through its lever 205 (Figs. 6 and 8) and the inclined face 210 slides below the slide 189, elevating it. The slide 189, through the tail end 196 of flap 195, finally causes the zero stop 203 to engage in the zero setting wheel 125 of the 100 place of the cross totaliser 12.

When the unlocking shaft is turned as described, a pin 518 (Figs. 13 and 14) on the arm 512 engages the upper edge of a lever 519 on a shaft 520 mounted to rotate in the front and rear walls of the calculating mechanism. Levers 521 and 522 are keyed on this shaft. Pins 523 and 524 riveted in the levers engage in the grooved boss of a spur gear 525 mounted to turn freely on shaft 50. Clutching members on the spur gear engage in suitable notches in a flange 526 which is keyed on the shaft 50.

The shaft 520 is turned clockwise by the pin 518 on the arm 512 against the pull of a spring 527. A third lever 528 on the rear end of the shaft 520 is equipped with a tooth at its free end with which it engages, and is locked by a tooth 529*a* of a rocker 529 which is fulcrumed at 530. The turning movement of the shaft 520 is transmitted to the spur gear 525 which is now engaged with the teeth 532 of a zero setting slide 531 which is mounted to slide vertically in the left hand portion of the calculating mechanism.

Upon the further downward movement of the unlocking slide 506, a dog 533 on the slide engages a pawl 535 which is pivoted to a catch 534, and turns the pawl. A lug at the end of the pawl 535 engages the catch 534 and turns it clockwise against a spring 536, withdrawing a tooth at the end of the catch from a rack 537 on the zero setting slide 531, and a rack 538, under the pull of a spring, not shown, now moves the slide down, arrow 543, through pinion 539, shaft 540, pinion 541 and rack 542 on the slide. The rack 538 moves in the direction of the arrow 544 and, together with a pin 545 on the still descending unlocking slide 506, effect in sequence the typewriting of the value to be withdrawn from the cross totaliser 12.

The total taking operation from the positive cross totalizer 12 in the complementary unit K

The zero setting wheels 125 of the cross totaliser 12 (Fig. 5) mesh with driving wheels 261 which, through intermediate pinions 262, turn the spur gears 263 of the number rollers 264. As described in the preceding paragraph "The zero stop mechanism for the cross totaliser 12" and elsewhere, the 100 place roller 264 in the present example is connected to the spur gear 35 keyed on the shaft 34 through its driving wheel 261 (Figs. 3 and 7), and the spur gear 35 is connected to the shaft 50 through the train of gears 76, 75, 68 (Fig. 7) and the shaft 50 is connected to the zero setting slide 531 by the spur gear 525. (Fig. 13).

The zero setting slide 531 which has now been released from the camplate 502 (Figs. 12, 13, and 14) through the unlocking slide 506 now rotates the driving wheel 261 (Fig. 5) of the 100 place in the cross totaliser 12, through the mechanism described. The driving wheel 261 is turned until the distance of the zero setting tooth of the zero setting wheel 125 has become exhausted. This distance is determined by the value to be canceled—in the present instance "1"—and is equal to one pitch from the zero stop 203. As soon as the zero setting tooth of the zero setting wheel 125 has engaged the zero stop 203 (Fig. 8), the corresponding number roller 264 (Fig. 5) displays "0" in the window of the cross totaliser 12. The descent of the zero setting slide 531 (Fig. 13) is now completed.

The writing of the number "1" in the first line, column V of form 25 which has been prepared by the zero setting slide 531 is now effected by the pin 545 on the unlocking slide 506 (Fig. 13) acting on mechanism which has not been shown.

Previously after the unlocking slide had completed its descent, a slide 553 at the left of the calculating mechanism (Fig. 13) was shifted in the direction of the arrow 559 through mechanism 554, 555, 556, 557 from the camplate 501 through a bolt 558 belonging to the typewriting mechanism by means not illustrated. The rocker 529 whose left arm 560 extends into a slot 561 in

the slide 553, is turned clockwise and the locking arm 528 is released. The arms 521 and 522, under the action of the spring 527, shift the spur gear 525 to the left and away from the rack 532 of the zero setting slide 531.

The ascending portion of the camplate 502 now raises the roller 507 (Figs. 13, 14, and 15) at the lower end of the unlocking slide 506 and the inclined edge 510 of the slide releases the catch 511. The unlocking levers 240 and 244 (Fig. 5) now return the members 515. 516 into their initial positions, and the cross totaliser 12 is locked again. At the same time, the shaft 204 is turned against the arrow *p* by the parts 243, 242, and 241, and the inclined edge 210 of the push rod 207 (Fig. 8) which is pivoted to the arm 205, is withdrawn from the slide 189. A roller 506*a* on the unlocking slide 506 engages a lever 554*a* fulcrumed in the calculating mechanism which is elevated and, through an eccentric screw 555*a* in the zero setting slide 531 returns the slide into its upper final position, the rack 537 moving idly past the tooth at the upper end of the catch 534.

Obviously during the operation described, the 100 place of the cross totaliser 13 has also been turned for one unit, that is, from "8" to "9", so that now the value "25" is in the totaliser 12, and "9999,975" is in the totaliser 13. The zero setting wheels of the cross totaliser 13 are free to turn as the corresponding zero stop 232 (Fig. 8) was not moved into active position.

When the type bar—not shown—returns, the carriage performs the step to the 10 place of the cross totaliser 12 in which place the same operations are performed, that is, in the 10 place the "2" is withdrawn from the cross totaliser 12 while the 10 place in the cross totaliser 13 moves from "7" to "9", so that now only the value "5" is read at the totaliser 12, and "9999,995" at the totaliser 13. The value "2" is written and the totalisers now move to the units place. Here, a similar operation occurs, the value "5" being withdrawn from the totaliser 12. In the totaliser 13, the "5" adds to "5" there, and the unit place moves to "0". Upon the transit from "9" to "0" a tens transfer occurs and all higher places move from "9" to "0". Now, both cross totalisers 12 and 13 are at "0".

When all number rollers 264 of the cross totaliser 12 (Fig. 5) are at "0", the half-high-teeth—not shown—of all zero setting wheels 125 by which the clear sign printing device is controlled, are aligned. Under these conditions, a control rail 270 (Fig. 5) can be influenced by the clear sign printing device 273, 272, 271, of known type, which partly surrounds the cross totaliser 12. The rail 270 engages the half-high teeth of the zero setting wheels, and the clear sign printing is begun.

When the cross totaliser 12 is returned to "0" in all places, and the canceled value "125" has been printed in the first line, column V of the form 25, as described, a hook 256 at one side of a plate 550 by which the idle totaliser 6 is closed at the bottom and which is bent at right angles at its lower end (Figs. 5 and 11) engages the pawl 253 on the arm 251 (Fig. 10) which has been described in the paragraph "Operation upon depression . . .". Since the pawl is in contact with the check B it cannot swing independently but swings the arm 251 anti-clockwise against the action of its spring 551. The universal part 250 (Fig. 10) which is pivoted to the arm 251 descends, engages the lug 155 at the tail end 153 of the lever 156 and turns the lever anticlockwise, like the arm 251. The movement of the lever 156 is transmitted to the lever 148 through the pin-and-slot connection 151, 152 (Fig. 10) and the lever 148, turning about its screw 149, turns the tail end 145 of the locking member 140 anti-clockwise by its lug 146. The locking member swings about its screw 552 and is disengaged from the locking bar 139. The cross total taking controlling member 136 is now free to return into its initial position under the pull of its spring 137, and clears the pin 167 of the lever 166 which is now turned anti-clockwise under the pull of the spring 177 through members 175, 171, 169, and 170. By these means, the tail end of the universal member 175 returns into the path of the clutching arm 178 (Figs. 10 and 12) and the camplate unit 501, 502 is again disengaged from the driving wheel T on the driving shaft 504.

Upon its return into initial position, the cross total taking controlling member 136 releases the selector lever 86 which now descends by gravity and its lug 93 releases the lug 100 of the bellcrank 95. Under the action of its spring 193 (Fig. 8) acting on the lever 185, the bellcrank 95 returns into its initial position and moves the slide 189 against the arrow *n* through the rod 182. Before this occurs the control plate 39 (Fig. 5) of the idle totaliser 6 has released the control lever 42 and the calculating mechanism is locked again. The flap 195 (Fig. 8) now returns into its initial position under the pull of spring 198 and the zero stop 203 moves clear of the zero setting teeth of the wheels 125 in the cross totaliser 12.

At the same time as the control plate 39 releases the lever 42, the control plate 41 of the idle totaliser releases the control bellcrank 43 (Fig. 7) and has returned the species of the cross totalisers to addition, and the selector 86 under the control of rod 77 returns into the initial position shown in Fig. 1.

The total taking operation from the negative cross totaliser 13 of the complementary unit K

In the first line of the form 25 (Fig. 16) there was a positive balance "125" in the cross totaliser 12 of the complementary cross totaliser unit K, in the calculation described by way of example. Correspondingly the other cross totaliser 13 of the unit K showed the complement "999,875". This was automatically cancelled when totalising from the cross totaliser 12 by the driving spur gears 35 and 36 which, as described, are connected to each other and at the same time engage with the same places of both cross totalisers.

The example illustrated in the second line of the form 25 shows a negative balance "110" in column VI. Assume that this balance has been calculated in the cross totaliser 13 of the unit K, and is to be written in the second line, column VI.

To this end the control plate 41 of the idle totaliser 7 is adjusted to "A", as, see the paragraph "The normal calculating . . ." the sequence of the numbers on the number rollers 264 of the cross totaliser 13 is the reverse of the cross totaliser 12.

The "100" decimal tabulator key 21 is now depressed, corresponding to the number "110". The idle totaliser 7 moves the cross totalisers 12 and 13 in the same direction by means of the links 14, 15 (Fig. 1*a*). By these means, the cross totalisers 12 and 13 are operatively connected to

the driving spur gears 35 and 36 with their 100 places. At the same time, the control plate 41 of the idle totaliser 7 moves over the control bellcrank 43 but this is not operated, since the control plate has been moved to "A". The selector lever 86 remains in its initial position, as described in the preceding paragraph, and shown in Fig. 1, and the recesses S of its hole 98 is below the head of the screw 99. As the bellcrank 43 is not operated, the operation in the cross totaliser 13 is addition. The driving wheels 261 (Fig. 5) of the cross totalisers 12 and 13 are now operatively connected to the shaft 50 through 36 (Fig. 7), 35, 45, 34, 74, and 68. Furthermore, the unlocking shaft 115 of the calculating mechanism is unlocked by the control plate 39 of the idle totaliser 7 (Fig. 5) acting on the locking lever 42.

When the cross-totalising controlling member 136 is depressed (Fig. 10), the cam plates 501, 502 (Fig. 12) are reconnected to the driving shaft 504 by means of the parts 167, 165, 166, 169, 170, 171, 174, and 175, and the tail end 175a of the universal member 175 releases the clutching arm 178 which now engages between the teeth of the driving wheel T on the driving shaft 504. The tail end 145 (Fig. 10) of the locking member 140 which is pivoted on the controlling member 136, engages the lug 146 of the lever 148 and turns the lever anti-clockwise. The movement of the lever 148 is transmitted to the lever 153 by the pin-and-slot connection 151, 152 which now bears slightly against the tooth 250a of the universal part 250 suspended from the arm 251, but without raising the universal part. The tail end 143 of the controlling member 136 shifts the selector lever 86 in upward direction, so that the lug 93 of the selector lever 86 acts on the lug L (Fig. 8) of the bellcrank 96 and turns the bellcrank clockwise. This movement is transmitted to the swinging lever 215 by rod 213 pivoted to it. The swinging lever 215 shifts the slide 219 in the direction of the arrow n and the inclined edge 239 of the slide engages below the tail end 225 of the flap 224, moving its zero stop 232 into slight engagement with the zero setting wheel 125 of the 100 place of the cross totaliser 13. When the controlling member 136 has arrived in its lowermost position, it is locked by the tooth 142 of its locking member 140 engaging in the groove 163 of the locking bar 139 where it is held by the spring 141 (Fig. 10).

The camplate 502 (Fig. 12) now allows the roller 507 (Figs. 13 to 15) at the lower end of the unlocking slide 506 to descend and the slide now operates the catch 511 and, through this, turns the unlocking levers 240 in the direction of the arrow p (Fig. 5) and the levers now unlock the cross totalisers 12 and 13 through their members 516, as described in the paragraph "The total taking operation from the positive cross totaliser 12 in the complementary unit K."

Simultaneously with the unlocking of the cross totalisers, the arm 233 (Fig. 8) which is keyed on the shaft 204, is turned and the slide 236 which is pivoted to the arm, engages below the slide 219 with its incline 238, elevates the slide and turns the flap 224 further in clockwise direction. The zero stop 232 is now moved into positive engagement with the zero setting wheel 125 in the 100 place of the cross totaliser 13.

A lug 533 on the unlocking slide 506 (Fig. 13) unlocks the zero setting slide 531 by acting on a pawl 535 on the slide. The zero setting slide whose rack has previously been engaged at 532 by the pinion 525 under the action of the locking lever 512, now descends and rotates the shaft 50 which in turn rotates the driving wheels 261 of the 100 place in the cross totalisers 12 and 13 through the train of gears 68 (Fig. 7), 74, 36, and 35. When the zero setting tooth of the zero setting wheel 125 of the 100 place of the cross totaliser 13 engages the zero stop 232, the corresponding number roller 264 displays "0" in the window of the cross totaliser 13. This arrests the descent of the zero setting slide 531 (Fig. 13), and at the same time the complementary number "8" which corresponds to the complementary value 999,980, in conformity with the value "1" of the 100 place of the cross totaliser 13, is brought to "9" in the cross totaliser 12 by spur gear 35 (Fig. 7).

The value "1" is now written in the second line, column VI of the form 25 in the same manner as in the cross totaliser 12 (Fig. 16). The carriage is now moved from the 100 place into the 10 place, etc. Here also, totals are taken in the manner described, and in the cross totaliser 12 tens transfer occurs from the 10 place into the 100 place, so that a tens transfer occurs in each higher place and the corresponding number rollers are brought to "0". When all number rollers 264 of the cross totaliser 13 display "0," all zero setting wheels 125 are aligned with their half-high teeth for clear sign printing whereupon printing is effected as described in the preceding paragraph.

After the total taking from the cross totaliser 13 has been completed, the cam plate 502 (Fig. 12) has returned the unlocking slide 506 into its initial position. The parts connected to the unlocking slide, for instance, the zero setting slide 531, return into their initial positions. The controlling member 136 is now unlocked in the manner described with respect to the total taking from the cross totaliser 12, and the complete unit 501, 502 is uncoupled from the driving shaft 504.

Total taking from the column totalisers 2 to 5

The column-total taking controlling member 176 (Figs. 7 and 12) is arranged to act on a lug 281 of a double-armed lever 282 with the upper edge 280 of its tail end. The double-armed lever 282 is fulcrumed at 283 about a screw on a bracket 282a connected to the lower side of the machine frame. A crooked connecting rod 284 is pivoted to the front arm of the double-armed lever 282 by a screw 285. The other end of the connecting rod 284 is pivoted to a link 287 at 286. An open slot 288 at the lower end 289 of the link 287 is placed about a pin 291 on the bar 290 of a changing-over key 16. There is a slight clearance between the pin and the upper end of the slot, so that the bar 290 can partake in the depression of the controlling member 176. On the other hand, the controlling member is not influenced by the bar 290.

The upper end of the link 287 is pivotally connected to a lever 292 keyed on the shaft 125.

When, after the booking of the first three lines of the form 25 (Fig. 16) the column totals of the debit and credit items in columns I to IV are to be found and written, this is done by writing the values accumulated in the column totalisers 2 to 5. To this end the carriage return key 18 is operated and thereupon the decimal tabulator key 21/"100" is depressed so that the principal driving wheel 38 of the calculating mechanism is first connected to the driving gear 549 of the 100 place of the column totaliser 2 which corresponds to the value 360, the total in column I. The dog 33a

of the column totaliser 2 moves the cross totalisers 12 and 13 into engagement with the driving gears 35 and 36 in places corresponding to the position of the column totaliser 2, by means of the links 14, 15. The control plate 39 (Fig. 5) of the column totaliser 2 acts on the control lever 42 and unlocks the mechanisms connected to the unlocking shaft 115 of the calculating mechanism. At the same time, the zero setting flap for the column totalisers—which has not been shown—is placed in its preparatory position.

The vertical column total taking controlling member 176 is now depressed (Figs. 7 and 12) and its upper edge 280 acts on a rod 180 which brings the zero stop—not shown—fully into engagement with the zero setting wheels 570 (Fig. 5), as also described in the said patent.

The upper edge 280 of the controlling member 176 also acts on the double armed lever 282 and moves the link 287 in the direction of the arrow "q" in Fig. 7. The upper end of the slot 288 in the link 287 now engages the pin 291 and depresses the bar 290 of the carriage return key, changing over the carriage. The link moving in the direction of the arrow q turns the lever 292 anti-clockwise and the levers 123, 122, and 124 partake in this movement. The lever 124 engages in the groove of the coupling sleeve of the gear wheel 127 with its pin 126 and moves the gear wheel 127 into mesh with a gear wheel x keyed on the driving shaft 37. The pin 121 of the lever 122 slides in the open longitudinal slot 293 of the slide 120 but does not influence the slide.

A locking member 293a is pivoted to the controlling member 176 by a screw 176a. The locking member partakes in the depression of the controlling member and, turning clockwise under the action of a spring 293b, engages in the groove 163 of the locking bar 139 with a tooth 293c (Fig. 10), where it remains. The upper edge 295 of the tail end of locking member 293a now bears slightly against a second tooth 294 on the lower end of the universal part 250 but does not raise the part.

A shoulder 179 at the lower side of the controlling member 176 (Fig. 12) acts on the plate 174 of the universal member 175 so that the member is turned and its tail end 175a releases the clutching arm 178 whereby the cam plate unit 501, 502 which serves for total taking and booking of the totals, is coupled to the driving shaft 504. The unlocking slide 506 is now released and unlocks the column totaliser 2 while the known zero stop moves into active position whereupon the zero setting slide 531 is released and effects subtractive total taking from the 100 place of the column totaliser 2.

The number roller 546 of the column totaliser 2 (Fig. 5) is driven by the following train of gears: 547, 548, 549, 38 (Fig. 7), 37, x, and 127 from the shaft 50. This shaft also drives the number rollers 264 of the 100 places of the cross totalisers 12 and 13 through the train 68, 74, 35, 36, 261, 262, and 263. As the position of the column totalisers 2 to 5 is the same as for the calculations in the first three lines of the form, the value "3" is introduced positively in the cross totaliser 12.

When the number roller of the hundreds place in the column totaliser 2 has been returned to "0," the number "3" is written in the fourth line, column I of form 25 (Fig. 16). The carriage now moves to the tens place. After in this manner, progressing from the highest to the lowest place, the value "360" has been withdrawn from the column totaliser 2, transferred to the cross totalisers 12 and 13 of the complementary unit K, and written, the tooth 256 of the column totaliser 2 (Figs. 5 and 11) strikes the pawl 253 (Fig. 10) and, together with the pawl, turns the arm 251 anti-clockwise so that the universal part 250 descends. Its tooth 294 (Fig. 12) now engages the upper edge 295 of the tail end of the locking member 293a and releases the member which now returns into its initial position together with the column total taking controlling member 176. The universal member 175 is liberated and its spring 177 returns its tail end 175a into reach of the clutching arm 178, releasing the cam plate unit 501, 502.

Total taking is now performed in the column totalisers 3 to 5 in a similar manner as described and the corresponding amounts are transmitted to the complementary unit alternately in positive and negative direction, as is known in the art. The totals withdrawn from the column totalizers are written in italics which is effected by the changing over of the carriage, as described.

The completion of the booking operation

When the added totals of columns I to IV have been written down from the column totalisers 2 to 5, and transferred to the cross totalisers 12 and 13 of the complementary unit K, the balance which has been calculated in the unit in the meantime, is written down in the column V or VI and the booking is then finished. In the present instance, the cross totaliser 12 shows a positive value "5", and the cross totaliser 13 shows the corresponding complementary value 99999,995. The decimal tabulator key 21 for the value "5" is now depressed and the idle totaliser 6 moves the cross totalisers 12 and 13 with their unit places into mesh with the driving gear wheels 35 and 36. The permanent change over key 651 (Fig. 3) is now operated and the key plate 23 of the cross total taking controlling member is depressed whereupon the cross totaliser 12 is written clear, as mentioned, and returned to zero together with the cross totaliser 13. The value 5 is written in an italic in the fourth line of the column V.

When total taking has been completed, all parts involved return into their initial positions, as fully described above. The change over mechanism is returned into initial position by depressing the change over key 17.

The arrangement for two normal cross totalisers

By way of example, a booking and accounting operation has been described but the machine can also be used for other purpose, such as the calculation of pay, or the like.

As another example a form 600 is illustrated in Fig. 17 in which the freight and passenger trains of two railway lines A and B are booked separately, and added up separately after three days.

The numbers of freight trains in the columns I and III of form 600 are introduced in the column totalisers 2 and 4 and in the positive cross totaliser 12a (Fig. 2), and the numbers of passenger trains in the columns II and IV of the form are introduced in the column totalisers 3 and 5, and in the cross totaliser 13a which is also positive. Finally, each cross totaliser 12a and 13a is clear written independently, and one after the other, the corresponding values are transferred to column totalisers 6a and 7a replacing the idle totalisers 6 and 7, and written down in the columns V and VI of the form 600.

For this mode of calculation, certain modifica-

tions in the machine are necessary, as will now be described with reference to Figs. 2, 4, and 9.

The drive of the cross totalisers 12a and 13a

In order to rotate selectively the gear wheels **35** and **36** which operate the cross totalisers **12***a* and **13***a* (Figs. 2, 4, and 9) the screw M which holds the coupling lever **103** in its neutral position, (Figs. 3 and 7) is removed. The link **102** has an extension which is connected to the lever **103** by a screw **106** (Figs. 4 and 9) and its connection to the lever **44** is effected by a screw **105** in a U-shaped arm of the lever **44**. A spring **109** is secured to a lug **103***b* on the coupling lever **103** and its other end is secured to an eye **601** in the rear wall of the calculating mechanism casing (Fig. 4). The spring **109** turns the coupling arm **103** clockwise until its extension **110** bears against the said rear wall. The coupling arm is now in its initial position. By its pin **107** engaging in the groove of the coupling sleeve **45**, the coupling arm, when in this initial position, moves the teeth **111** of the sleeve into mesh with the teeth **46** on the boss of the driving wheel **35** and this wheel is now in driving position. The control lever **44** is arranged to be turned anti-clockwise by the control plates **40** (Fig. 5) in the column totalisers **3**, **5**, and **7**.

The zero stop mechanism for the cross totalisers 12a and 13a

Since in the example now under discussion either the cross totaliser **13***a* or the cross totaliser **12***a* is to be clear written, the zero stop can be controlled in unison for both cross totalisers. This is effected by dispensing with the tail end **225** of the flap **224** (Fig. 8), and with the allotted parts **96**, **213**, **215**, **219**, **233**, and **236**, and by combining the zero stops **203** and **232** of the respective flaps **195** and **232** into a single member, as shown in Fig. 9.

As the values to be calculated in the cross totalisers **12***a* and **13***a* are introduced additively, the totals calculated in the cross totalisers must be withdrawn subtractively. To this end, the control plates **41** (Fig. 5) in the column totalisers **6***a* and **7***a* (Fig. 2) are adjusted to "S" and the control lever **43** is moved clockwise when one of the said column totalisers moves into calculating position. The selector lever **86** is caused to partake in the movement of the column totalisers, by the rod **77**, whereby the slot **101** in the lug **97** of the selector lever **86** is positioned below the screw **99**, and the plate **93** engaged below the lug **100** of the bellcrank **95**. The bellcrank **95** can now be operated and the zero stop **203**, **232** moves into the path of the zero setting wheels **125** in the cross totalisers **12***a* and **13**. In all other positions the selector lever **86**—which is operated by the key plate **23** of the controlling member **136**—cannot be raised, as in this case its plate **93** strikes against a pin **605** (Figs. 2 and 9) from below. The pin **605** is secured in one arm **606** of an angle member **607** which is riveted to the inner side of the front wall **81** of the calculating mechanism. Consequently the controlling member **23** can only be operated if the cross totalisers **12***a* and **13***a* are clear written through subtraction.

The normal calculating and writing operation under the conditions given by the bookings in the columns I to VI of the form 600, Fig. 17

The column totalisers are adjusted, including their tabulator riders, and the cross totalisers are secured and moved, exactly as described in the paragraphs relating to the form **25** in Fig. 16.

At the beginning of a booking operation in the form **600**, the carriage is moved into its final position at the right by depressing the carriage return key **18** (Figs. 1, 3, and 4). Thereupon the tens tabulator key **21** which corresponds to the value "30" in the first line, column I, of the form **600** is depressed and the column totaliser **2** (Fig. 2) is moved into calculating position with its tens place. The control plate **39** of the column totaliser **2** acts on the lever **42** and releases the locking of the unlocking shaft **115** by the parts **113** and **114** in Fig. 5, in manner per se known.

Since the column totaliser **2** is without the control plate **40**, the lever **44** (Fig. 9) and the coupling sleeve **45** remain in active relation to the driving wheel **35**. The controlling lever **43** which controls the change gear **68**, **75**, **76**, **74**, remains in its initial position, since the control plate **41** for the species of the cross totalisers **12***a* and **13***a* has been moved to "A" (Fig. 11). The change gear therefore remains in the addition position determined by the gears **68** and **74**. When the value "30" is now calculated in known manner, it is transferred additively into the column totaliser **2** and into the cross totaliser **12***a*, since the knob **48** (Figs. 1, 3 and 4) has been adjusted to "A."

The column totaliser **3** is now moved into calculating position, in conformity with the value "40," first line in column II of form **600**, by depressing the corresponding decimal tabulator key **21**. In this position, the control plate **40** of the column totaliser **3** acts on the controlling lever **44** (Fig. 9) which is turned clockwise and, through link **102** and coupling arm **103**, disengages the teeth **111** of the sleeve **45** from the teeth **46** of the driving gear **35** and engages the teeth **112** of the sleeve with the teeth **47** of the driving gear **36**. During the calculating operation, the value "40" is also additively transferred to the column totaliser **3** and to the cross totaliser **13***a*, the other parts being operated as described with reference to the column totaliser **2**. The column totalisers **4** and **5** are operated in the same manner as **2** and **3**.

Total taking from cross totalisers 12a and 13a

When booking has been completed in column IV of the first line in the form **600**, the cross totalisers **12***a* and **13***a* are clear written successively. The value "55" appears in the window of the cross totalizer **12***a* and the tabulator key **21** for the tens is operated accordingly. The column totaliser **6***a* and the cross totaliser **12***a* are moved into calculating position with their 10 places. The coupling sleeve **45** remains in connection with the driving gear **35** as the column totaliser **6***a* is without the controlling plate **40**, however, the column totaliser **6***a* acts on the lever **43** with its control plate **41** previously adjusted to "S" and this control plate **41** swings the lever **43** clockwise. The change gear which determines the species of the cross totalisers is now set for subtraction through parts **62** (Fig. 7), **63**, **64**, **65**, **69**, **70**, **67**, **71**, and the spur gear is operatively connected to the driving shaft **34** through pinions **75** and **76**. The rod **77** is moved by the control lever **43** and, in turn, moves the selector lever **86** whose lug **93** engages below the lug **100** of the bellcrank **95** and whose slot **101** engages below the screw **99**.

When the key plate **23** of the controlling member **136** is depressed, the lug **143** (Fig. 10) at its

tail end raises the selector lever **86**. The lug **93** of the selector lever acts on the bellcrank **95** (Fig. 9) which moves the slide **189** in the direction of the arrow *n* through parts **182**, **185**, **187**, and **188**. The incline **211** of the slide now engages below the tail end **196** of the flap **195**, and the flaps **195** and **224** are now turned clockwise, their zero stop **203**, **232** lightly engaging the zero setting wheels **125**, Fig. 5.

In the meantime, the clutching arm **178** by which the complete unit **501**, **502** (Fig. 12) is connected to the driving shaft **504** has been released by members **166**, **171**, and **175**, and the unlocking slide **506** (Fig. 13) is now free to descend. By its incline **510**, the slide unlocks the calculating mechanism, the tens place of the column totaliser **6***a*, and of the cross totalisers **12***a* and **13***a*, which is in calculating position, and the spur gear **525** is caused to mesh with the rack **532** of the zero setting slide **531**. Simultaneously with the unlocking of the calculating mechanism, the slide **207** is moved to the rear by parts **115** (Fig. 5), **243**, **241**, **204**, and **205** (Figs. 6 and 9). The incline **238** engages below the slide **189** which is elevated and swings the flap **224** further in clockwise direction. The zero stops **203** and **232** now come into full engagement with the zero setting wheels **125** of the cross totalisers **12***a* and **13***a*. The zero stop **232** which cooperates with the zero setting wheel of the cross totaliser **13***a*, is used for a purpose to be described below.

After the zero stops **203** and **232** have been swung, the zero setting slide **531** (Fig. 13) is unlocked by the unlocking slide **506** engaging the pawl **535** and the shaft **50** (Figs. 9 and 13) is rotated. The shaft, through parts **68**, **75**, **76**, and **35**, rotates the driving wheel **261** of the 10 place in the cross totaliser **12***a*. The rotation is completed when the zero stop belonging to the cross totaliser **12***a* on the zero setting wheel is struck, and the return of the number roller **264** to "0" is now completed. The value "5" which is to be withdrawn from the 10 place of the cross totaliser **12***a* is transferred additively to the column totaliser **6***a* from shaft **50** through parts **127** (Fig. 7), **132**, **133**, **134**, **37**, and **38** whereupon the number "5" is written down in the first line, column V, of the form. The carriage now moves from the tens to the unit place, after the unlocking slide **506** and the zero setting slide **531** (Figs. 13, 14, and 15) have been returned into their initial positions. Otherwise the total taking from the cross totaliser **12***a* is effected in the same manner as in the first example, and need not be described.

When the cross totaliser **12***a* has been clear written, the tens key of the tabulator **21** which corresponds to the value "75" is operated in conformity with the amount which is present in the cross totaliser **13***a*. The cross totaliser **13***a* and the column totaliser **7***a* are now moved into calculating position with their tens place. The controlling plate **40** in the column totaliser **7***a* swings the control lever **44** (Fig. 9) anti-clockwise, so that the link **102** which is pivoted to the lever **44**, and the coupling arm **103** place the coupling sleeve **45** into mesh with the teeth **47** of the driving spur gear **36** with its teeth **112**. At the same time, the connection between the sleeve **45** and the driving spur gear **35** is broken. The control plate **41** of the column totaliser **7***a* which is also set to "S" operates the control lever **43** and, through parts **68**, **75**, **76** and **36**, (Fig. 9) returns the change gear for operating the cross totalisers into its subtraction position. At the same time, the zero stops **203** and **232** are moved into their preliminary position and the selector lever **86** is swung into its active position. The key plate **23** of the controlling member **136** is now depressed, effecting the automatic clear writing of the cross totaliser **13***a*, as described above for the total taking from the cross totalisers **12** and **13**. The total taking is completed when the value "5" has been printed in the first line, column VI of form **600**. All parts involved in the total taking operation are returned into their initial positions, as described.

When the bookings have been performed in the first three lines of the form, and in columns I to VI, the amounts shown in the fourth line of the form **600** which are added in the column totalisers **2** to **5**, **6***a*, and **7***a*, are written out, as described in the paragraph "Total taking from the column totalisers **2** to **5**," and the booking operation on the form **600** (Fig. 7) is now completed. When writing out the amounts from the column totalisers **6***a* and **7***a*, the totalisers are placed in their left-hand final position where they are locked by a bolt **700** (Figs. 1 and 1*a*) so that no values can get into the cross totalisers **12***a* and **13***a* which have already been set to zero.

Although the locking members **140** and **293***a* are released in dependence of the carriage movement, as described, they might also be released from the camplate unit **501**, **502**, without departing from the gist of the invention. In this case, if, for instance, a figure having three numbers is to be written out, a slide is advanced for three units by the "100" decimal tabulator key and returned step by step into its initial position by a dog at the camplate unit **501**, **502**. In the zero position, the slide engages the locking members **140** and **293***a* and releases them, whereupon the total taking operation is completed.

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FRITZ SCHMIDT.

[illegible]

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TOTAL-TAKING MECHANISM
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Serial No.
219,076
15 Sheets-Sheet 1

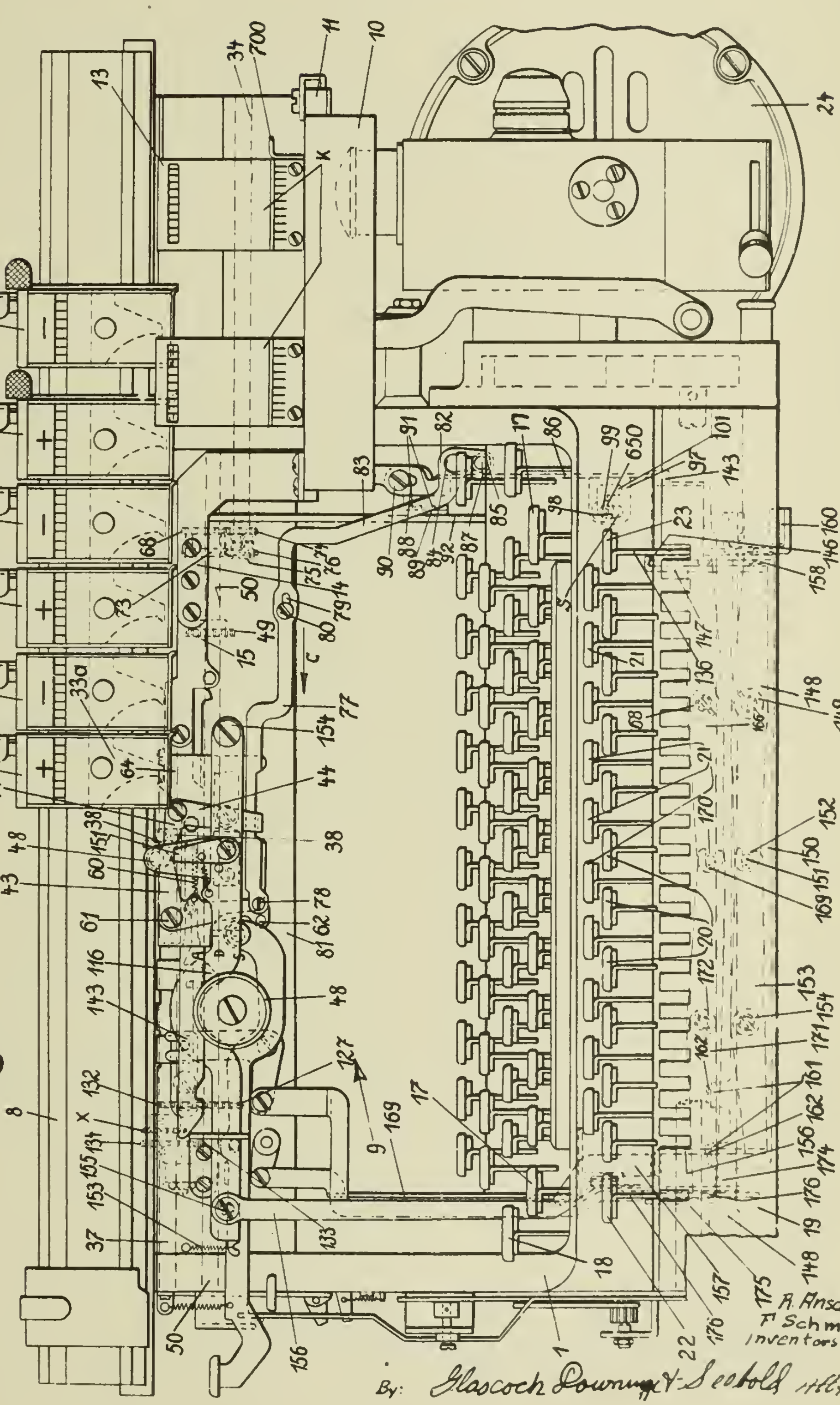

Fig. 1.

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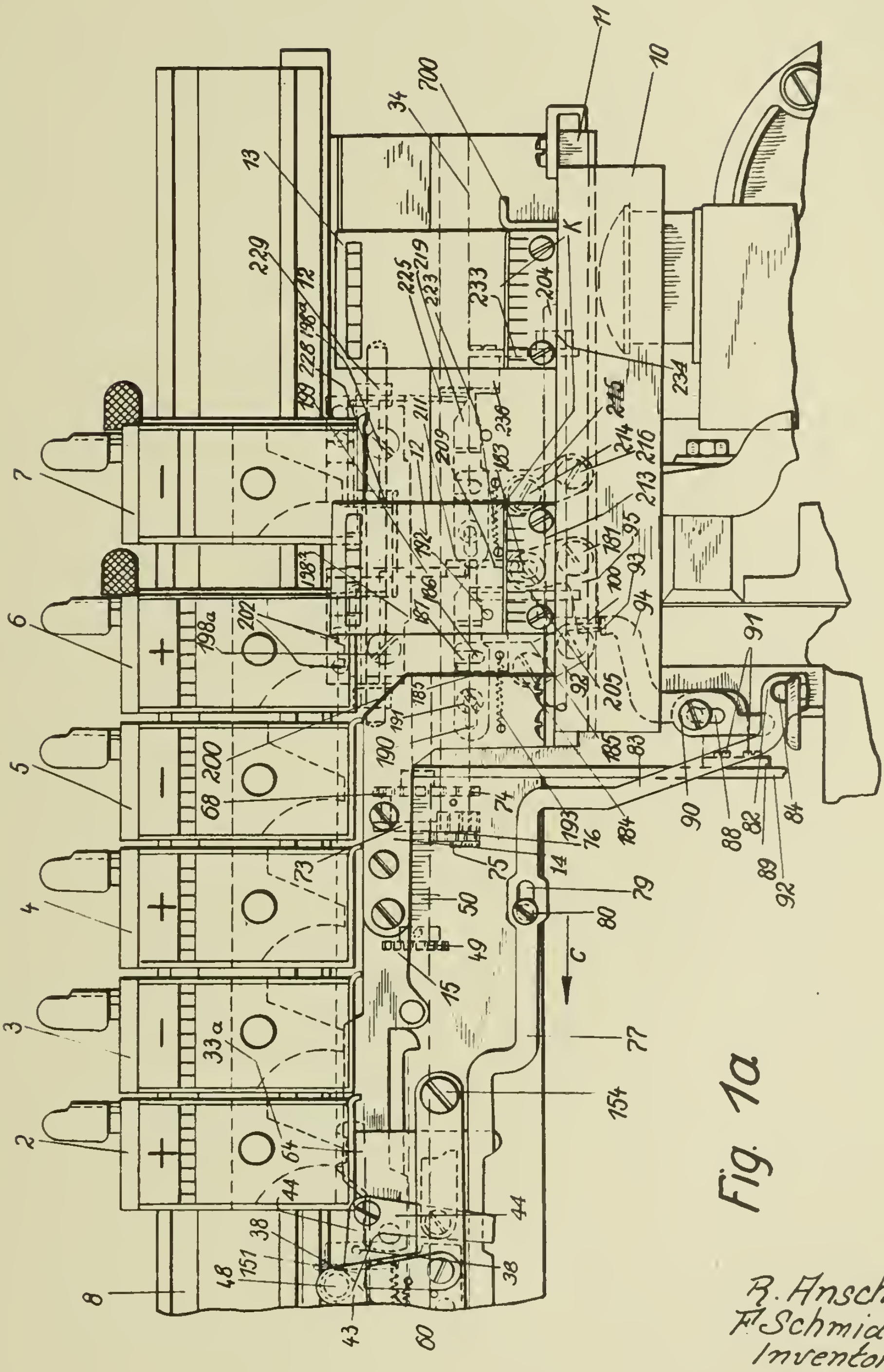

Fig. 1a

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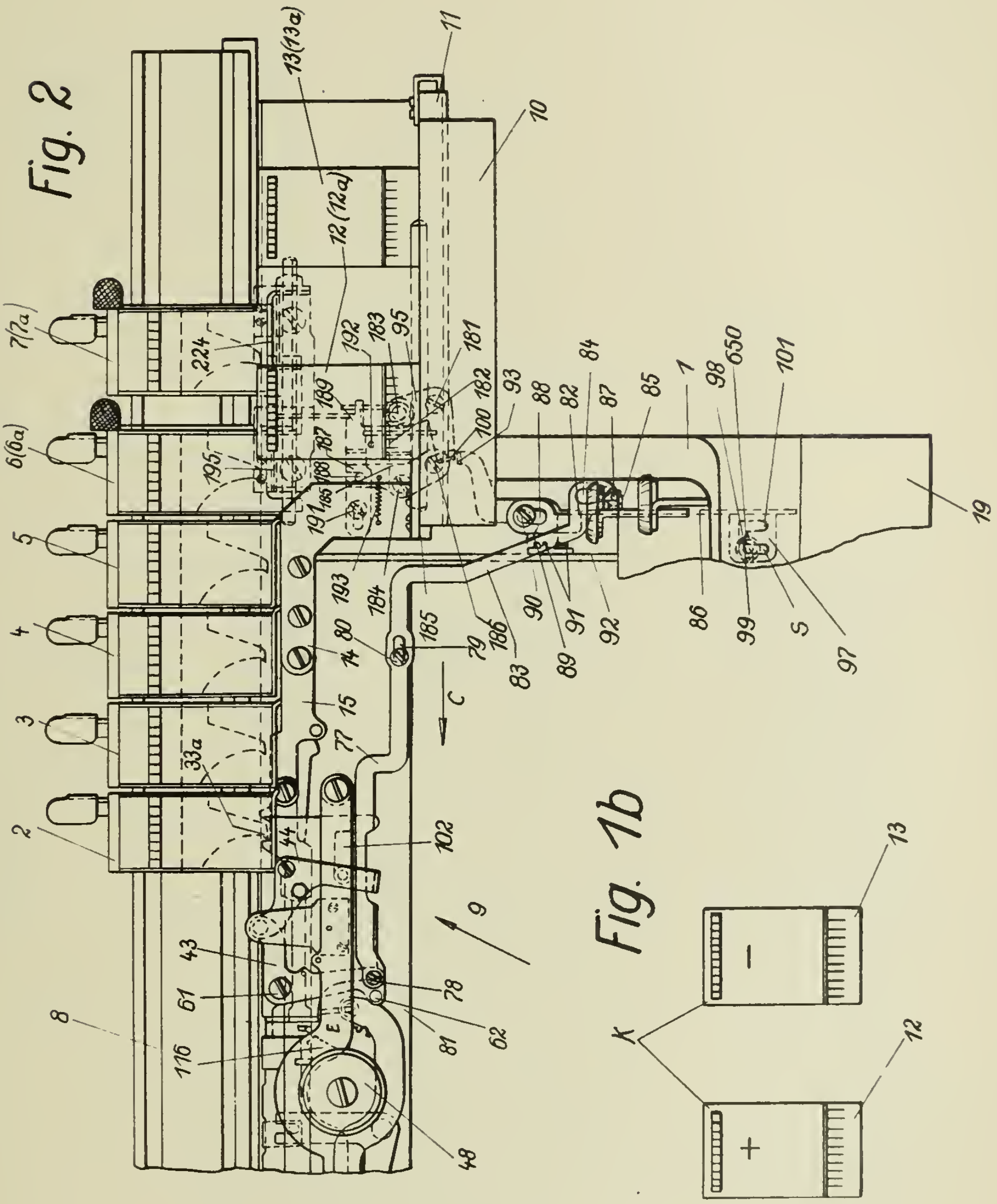

Fig. 2

Fig. 1b

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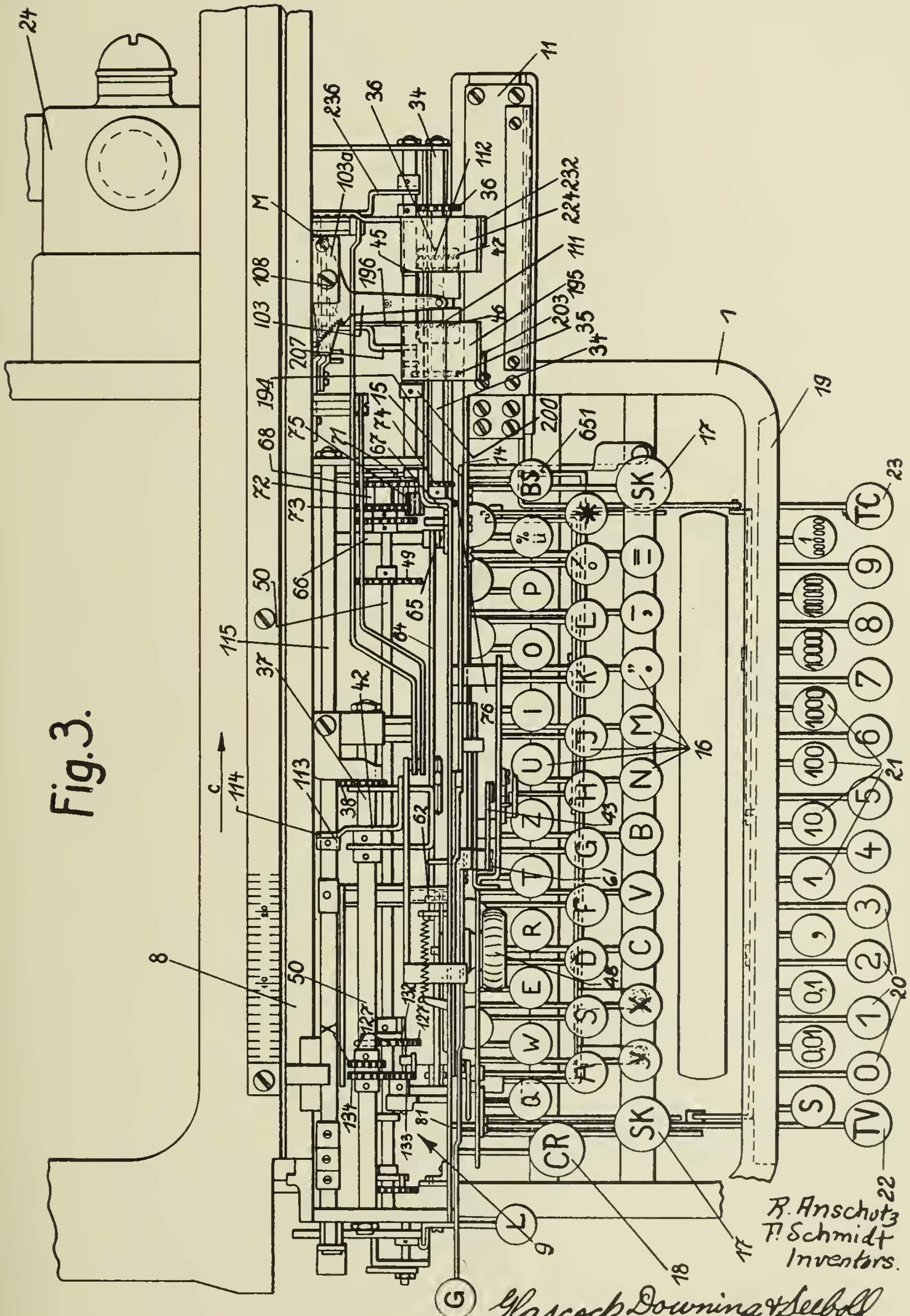

Fig. 3.

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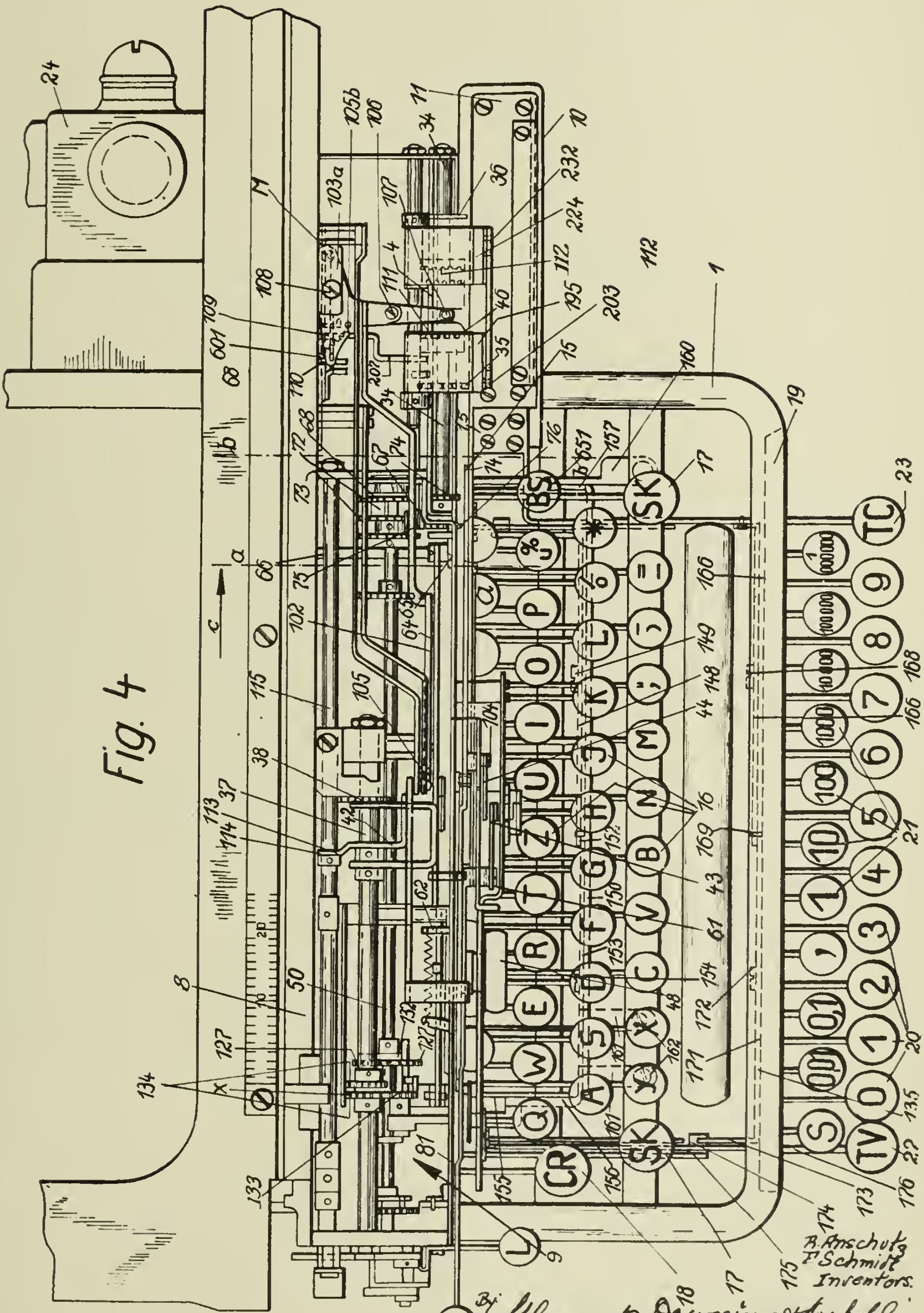

Fig. 4

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Fig. 5.

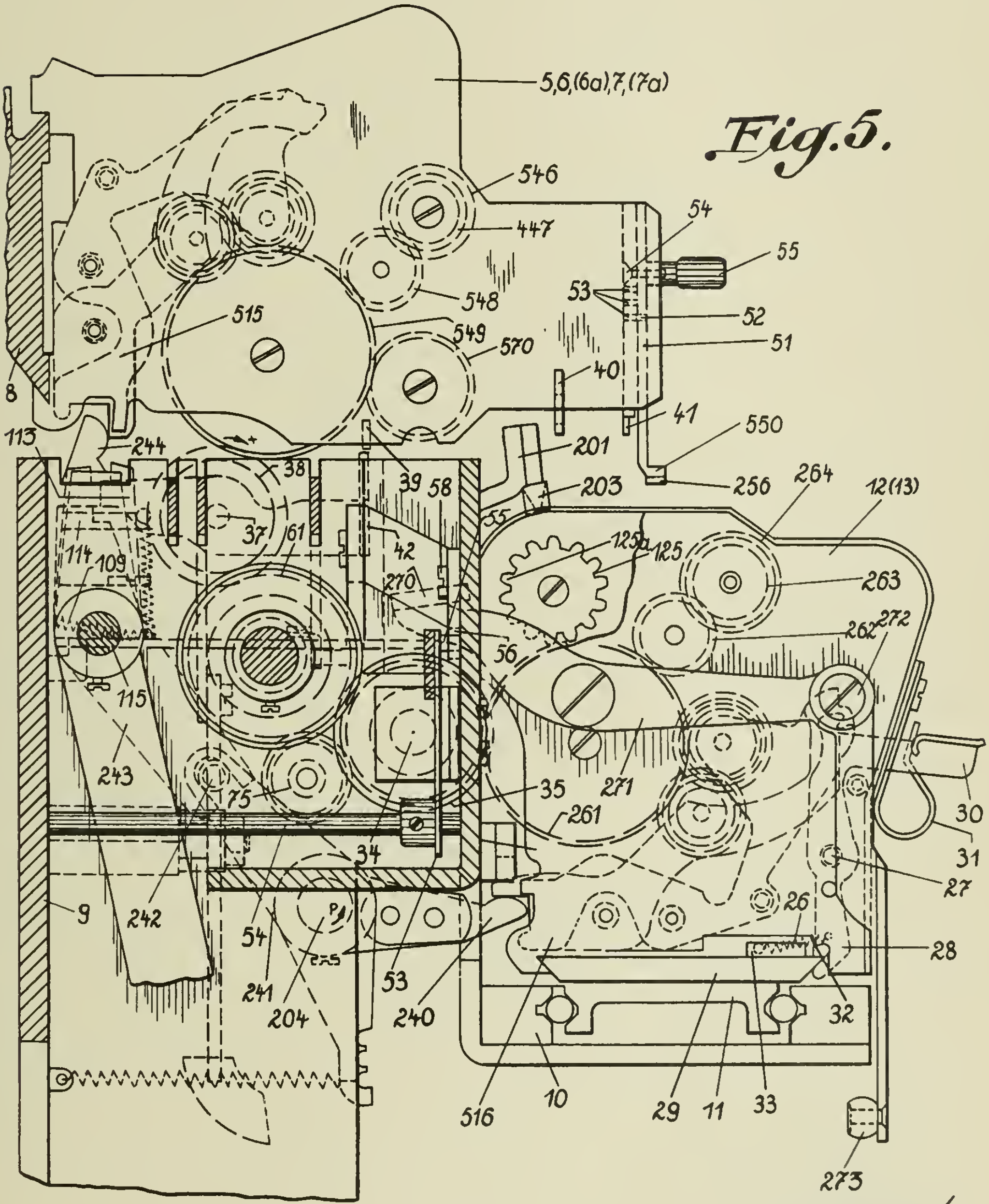

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Fig. 6

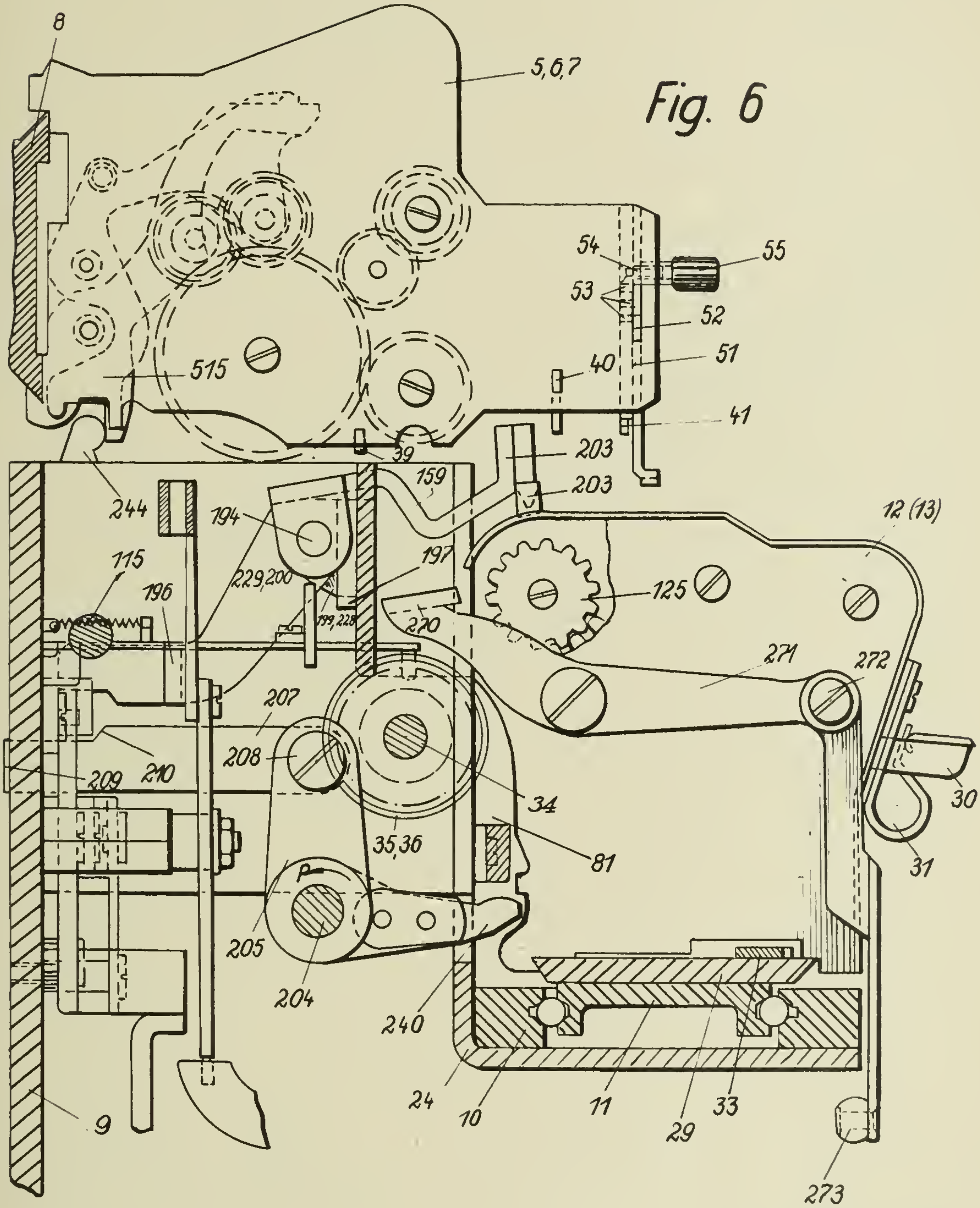

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Fig. 7.

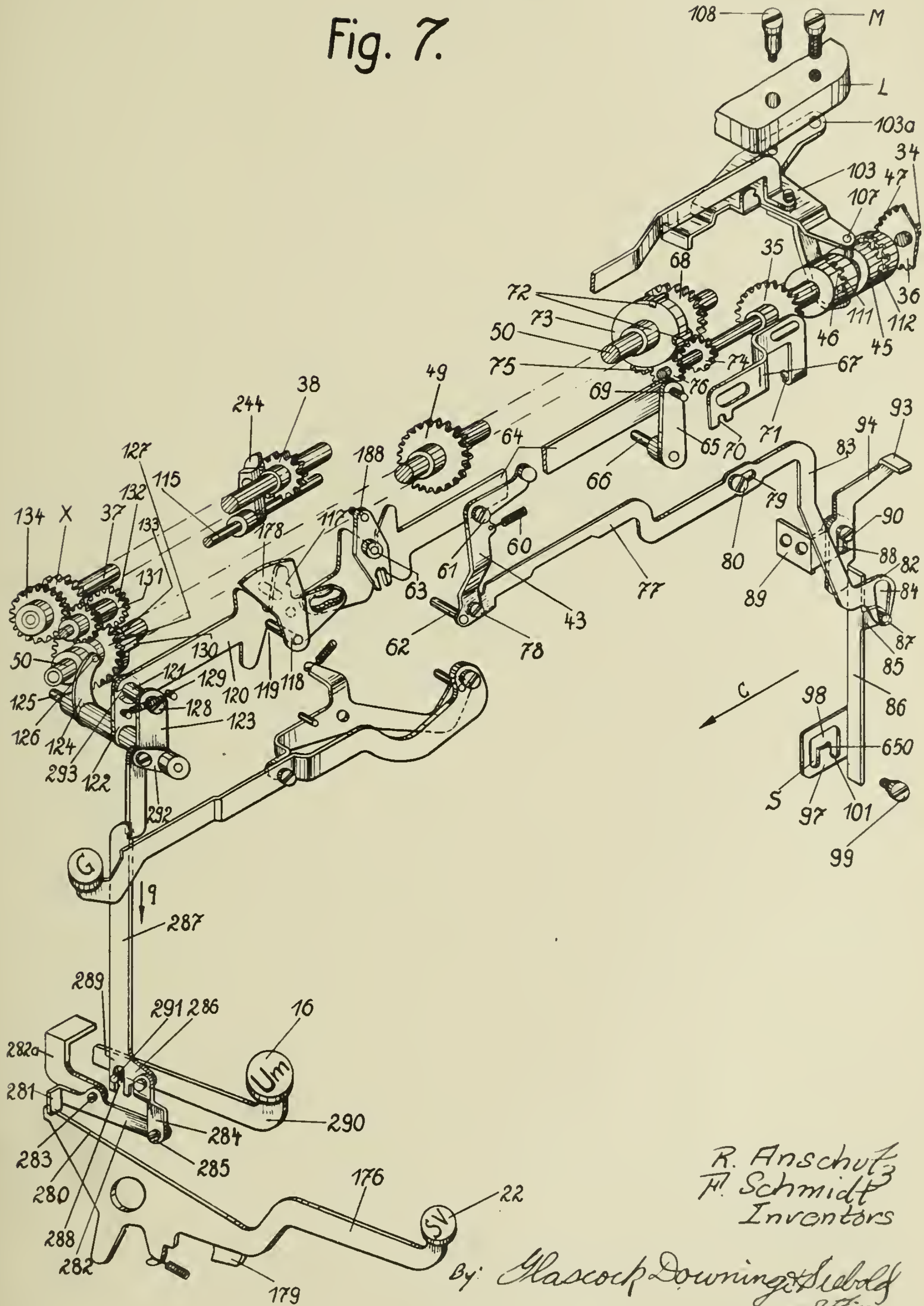

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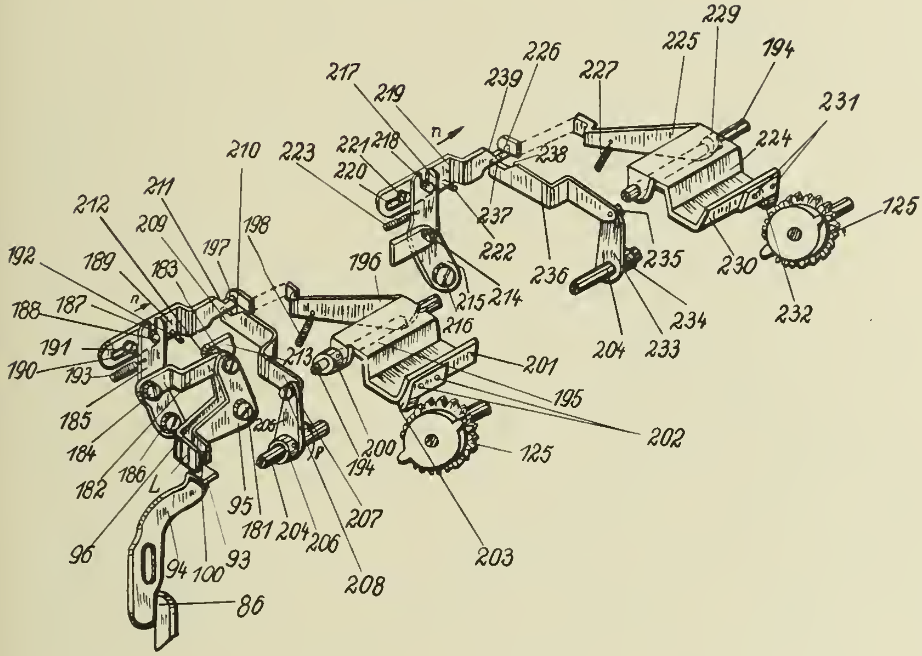
Fig. 8



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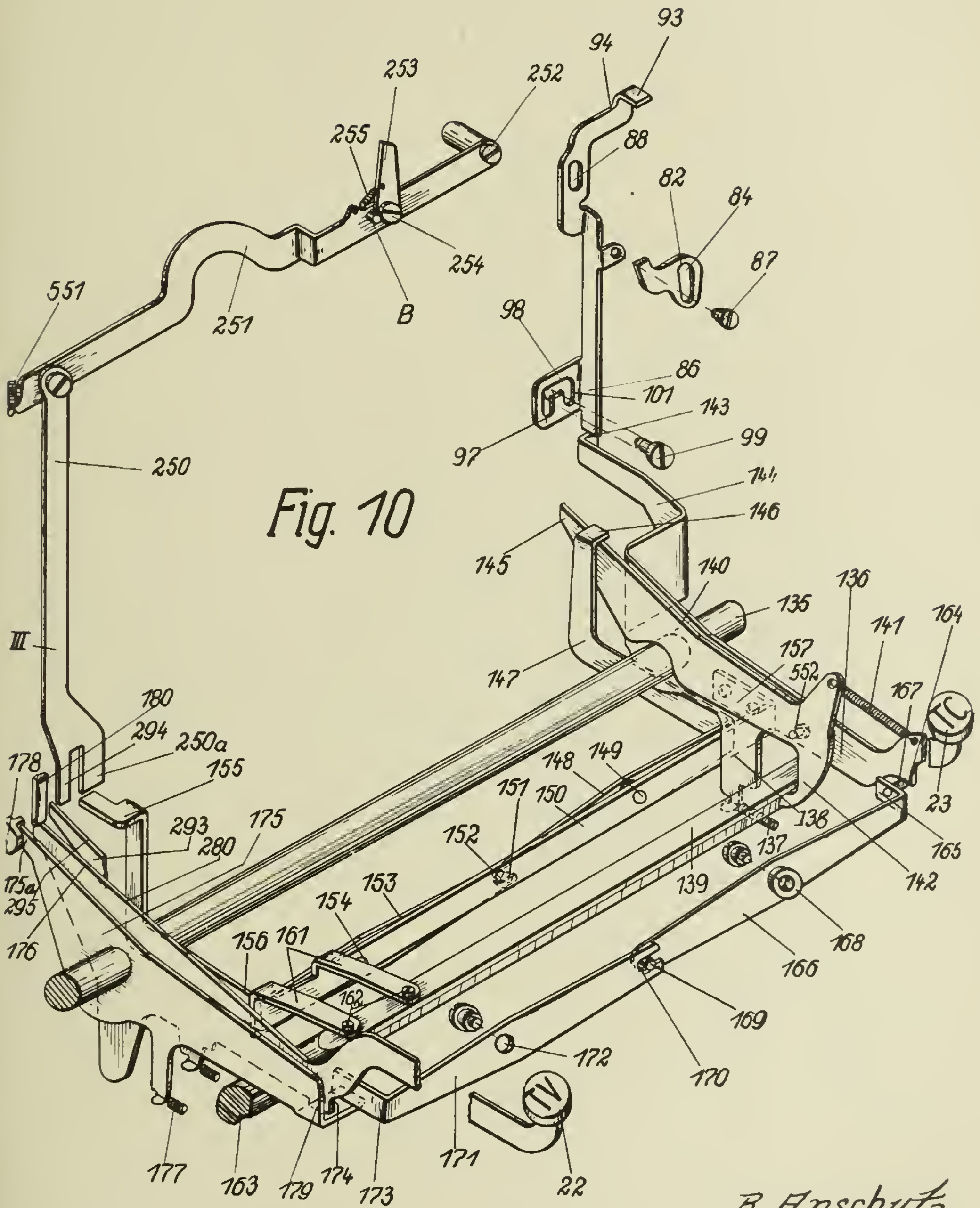

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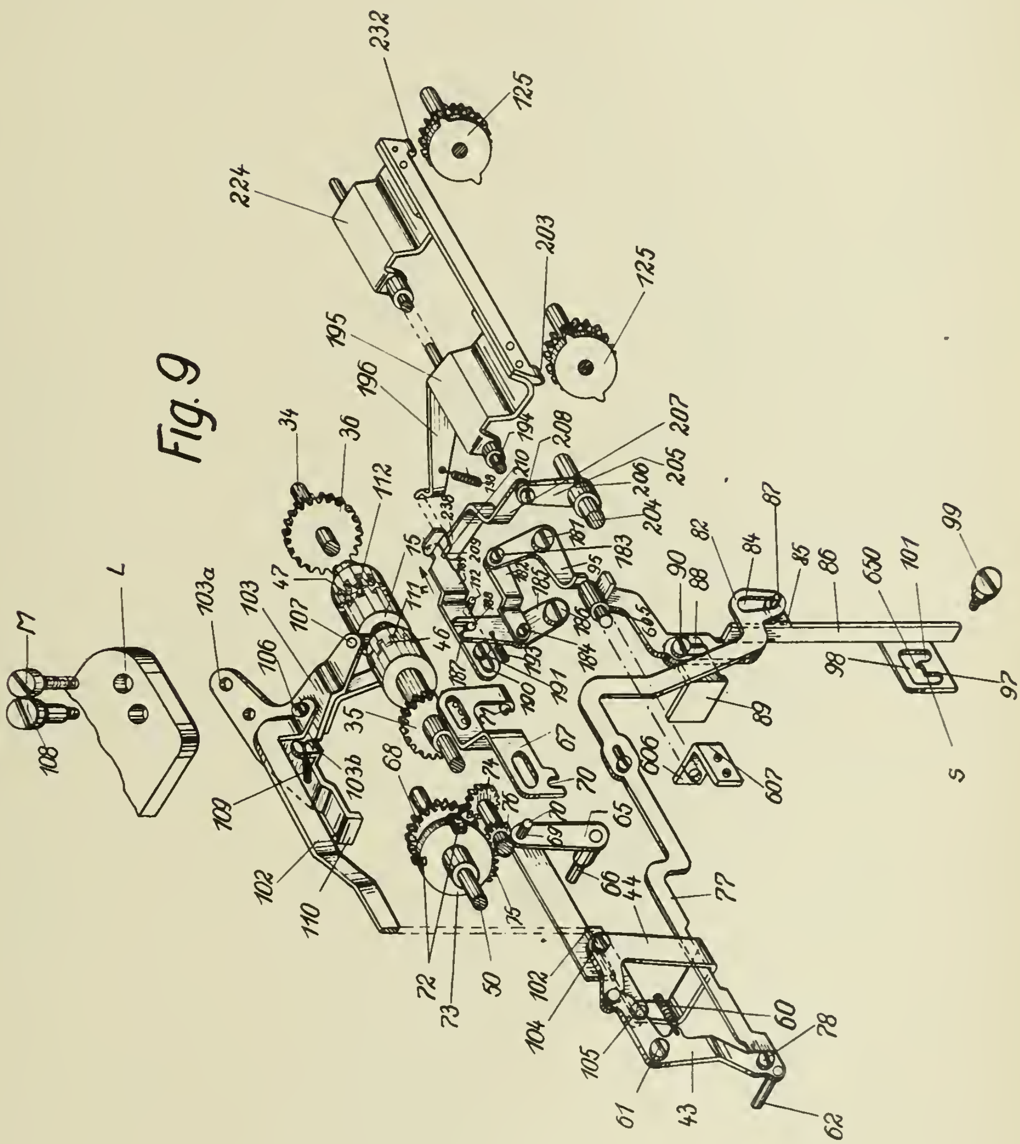

Fig. 9

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Fig. 12

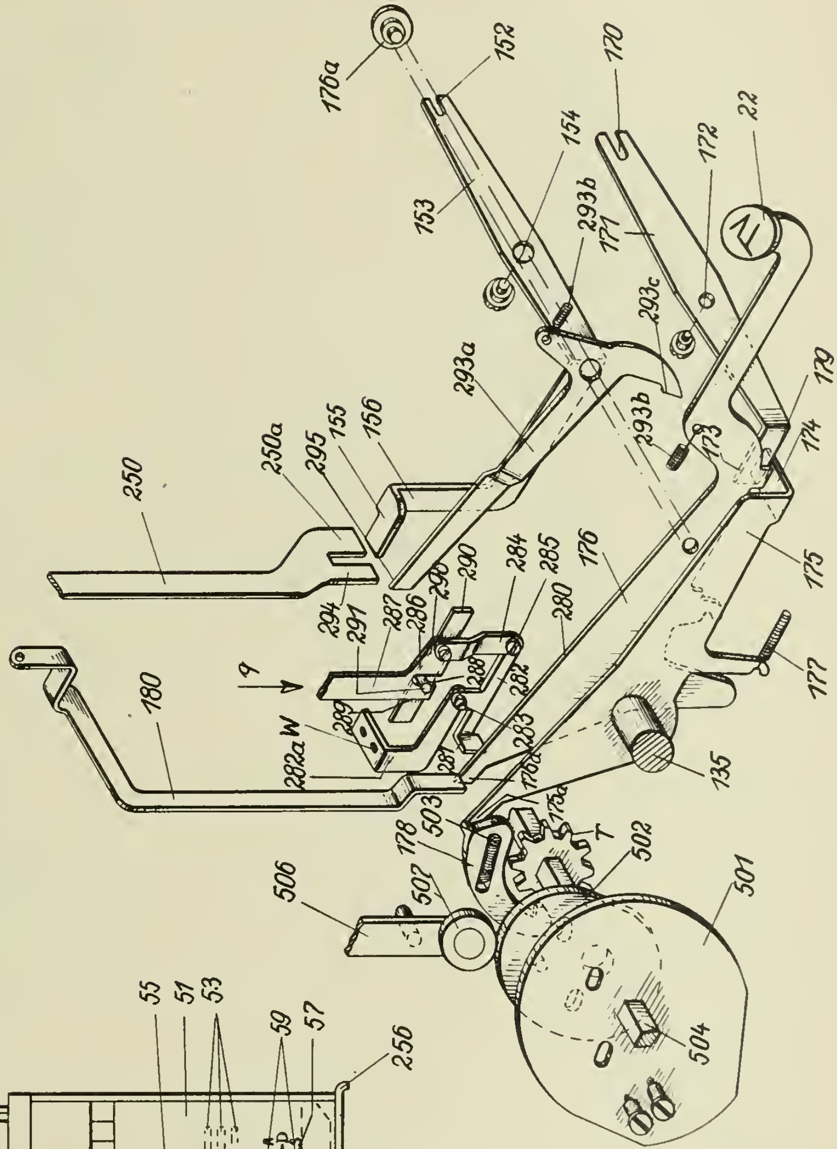

Fig. 11

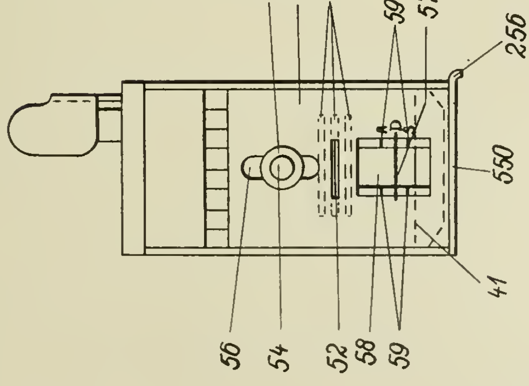

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Fig. 13

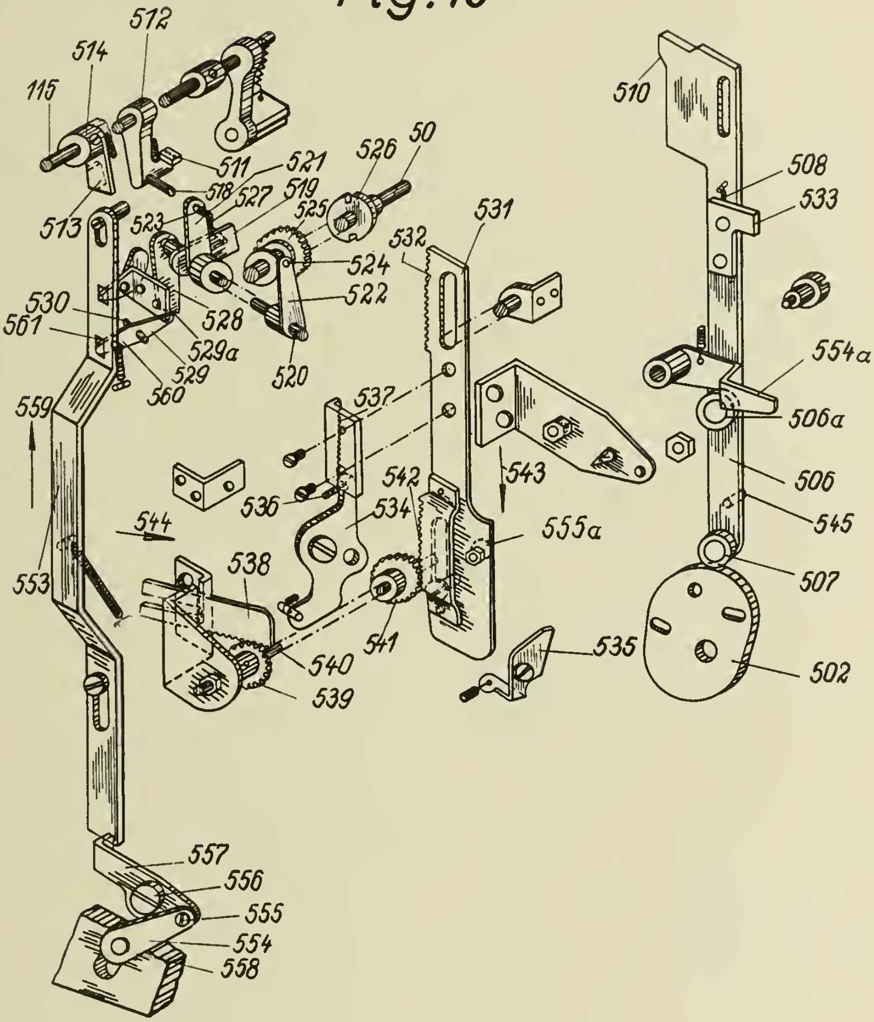

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Fig. 14

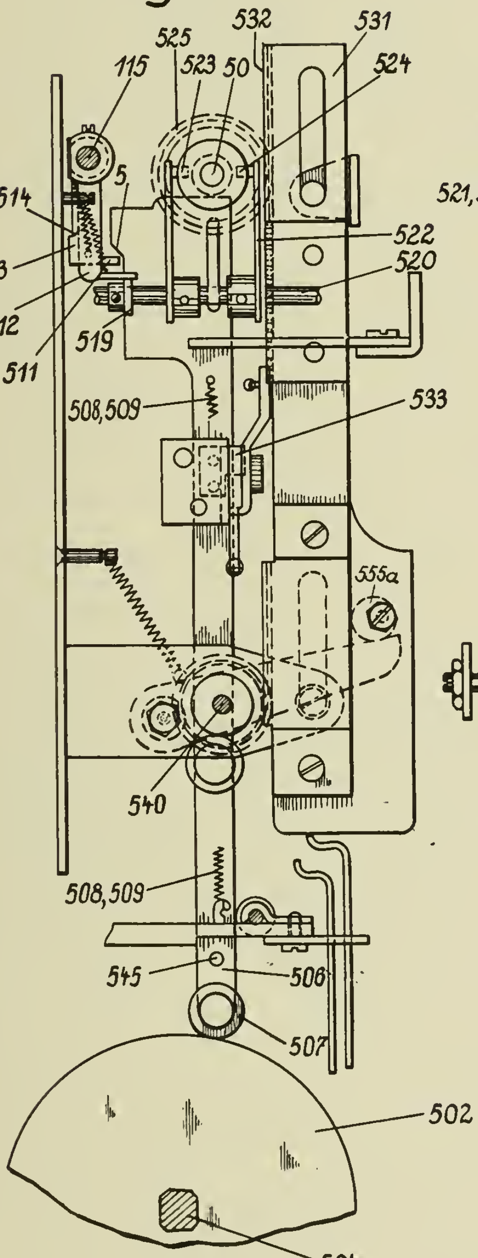
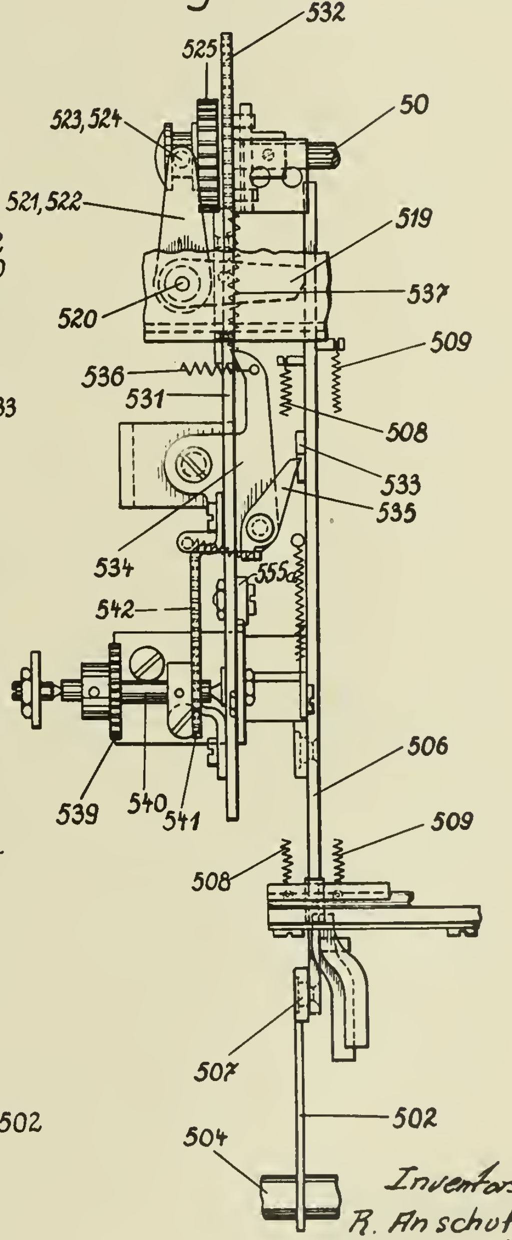


Fig 15



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25

Debit	Credit	Debit	Credit	Debit balance	Credit balance
220	40	25	80	125	
110	90	80	210		110
30	150	180	70		10
360	280	285	360	5	

I II III IV V VI

Fig. 16

600

Date	Section A		Section B.		Section A and B	
	Freight	Passenger	Freight	Passenger	Freight	Passenger
1.10	30	40	25	35	55	75
2.10	18	90	12	45	30	135
3.10	35	42	32	43	67	85
	83	172	69	123	152	295

I II III IV V VI

Fig. 17

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ALIEN PROPERTY CUSTODIAN

CALCULATING MACHINE

Robert Anschütz, Zella-Mehlis, Thuringia, and Richard Gröschel, Suhl, Thuringia, Germany; vested in the Alien Property Custodian

Application filed July 13, 1938

This invention relates to a calculating machine with a transfer device between at least one of the totalizers on the carriage of the machine and a value accumulator without tens transfer.

This invention is an improvement of the machine described in co-pending application Ser. No. 668,120.

In this machine, the accumulator key must be operated twice for transferring a value which is in a totalizer, to a value which is already in the value accumulator. When the accumulator key is operated for the first time, the value in the accumulator is added to the value in the totaliser and the tens transfer—if any—is effected by the tens transfer mechanism of the totaliser. The machine is then arrested and the accumulator key is operated for the second time. Upon this operation, the total obtained by the addition of the value in the totaliser and the value in the accumulator, is transferred to the accumulator.

It is the drawback of this machine that the accumulator key must be operated twice, for if the operator inadvertently does not operate it for the second time, a miscalculation will result.

This drawback is eliminated according to the invention, as follows:

Upon operation of a key which causes the operation of a transmission driving the totalisers from the value accumulator, a transmission driving the value accumulator from the totalisers is placed in readiness for action and, under the control of the first-mentioned transmission, drives the value accumulator from the totalisers.

In the accompanying drawing the invention is illustrated by way of example as adapted to a calculation machine of the type known as the "Mercedes-Euklid."

In the drawing

Fig. 1 is a perspective illustration of the machine.

Fig. 2 is a central vertical cross section, viewed in the direction of the arrow *a* in Fig. 1 and showing part of the shift mechanism of the machine, one of its totalisers, and the accumulator in its inactive position with respect to the totalisers.

Fig. 3 shows part of Fig. 2, with the accumulator in its active position with respect to the totaliser.

Fig. 4 is a perspective illustration of the accumulator and the mechanism for rotating its wheels, viewed from the front and the left.

Fig. 5 is a perspective illustration showing one of the accumulator wheels, the pin it rotates about, and the means for holding it against axial displacement.

Fig. 6 is a perspective illustration of the wheel, viewed in the direction of the arrow *c* in Fig. 5.

Fig. 7 is a section on the line 7—7 in Fig. 1.

Figs. 8 and 9 are elevations showing certain parts illustrated in Fig. 7 in their inactive and active positions, respectively.

Fig. 10 is a section on the line 10—10 in Fig. 1.

Fig. 10*a* is a perspective illustration showing certain parts illustrated in Fig. 10 remote from each other for the sake of clearness.

Figs. 11 and 12 are illustrations of the parts shown in Fig. 10, in elevation and in the inactive and active positions of the parts, respectively.

Fig. 12*a* shows certain parts illustrated in Figs. 11 and 12, in intermediate positions.

Fig. 13 is a perspective illustration of certain parts arranged at the left hand side of the machine, and viewed from the left in Fig. 1.

Figs. 14 and 15 are elevations of the parts illustrated in Fig. 13, in their inactive and active positions, respectively.

Fig. 16 is an elevation showing the value accumulator and value accumulator canceling keys in their initial positions, as viewed in the direction of the arrow *a* in Fig. 1.

Fig. 17 shows the keys depressed.

1. General description of the machine

The machine, as mentioned, is of the "Mercedes-Euklid" type. The mechanism of the machine is enclosed in a casing 1 whose elevated rear portion contains a carriage on which sixteen totalizers are arranged, and the value accumulator. The number rollers of the totalisers are read through holes S in the front wall of the elevated casing portion, and the indications of revolutions counters, also on the carriage, are read through holes S_1. A motor 7*a*, at the rear of the machine, operates its main driving shaft through a worm gear, not shown.

The machine is equipped with a key board having nine cross rows at sixteen keys 6, for introducing values through a shift mechanism. Special keys are arranged at the right and at the left of this key board. The keys at the right are: An addition key 8 (+), a subtraction key 9 (—), a key board cancellation key 11 (III), a totaliser cancellation key 12 (II), a cancellation key 13 (I) for the revolution counters, a triple multiplication key 14 (M), an accumulator key 16 (S), and an accumulator cancellation key 17 (SL). A controlling handle 10*a* for the addition and subtraction keys 8 and 9 pro-

jects from a slot in the top plate of the casing 1. When this handle is at "M," as shown, the shaft 145 of the shift mechanism rotates while one of the keys 8 or 9 is held in depressed position. When the handle is at "A," the shaft performs one revolution only upon depression of one of the keys. Another handle 15 controls the cancellation of the revolution counters during triple multiplication. Arranged at the left of the keyboard are a multiplication key 18 (×), a division key 19 (÷), and a correction key 20 (COR). A handle 21 is arranged for changing over from multiplication to division, and vice versa, and a handle 22 is arranged for interrupting the multiplication.

An inscription strip 23 is arranged in front of the key board. At its left hand end, the strip bears the inscription "Dividend" and, pitched to the right from this for seven keys, the inscription "Divider," indicating that the dividend must be introduced by depressing the keys 6 in the seven down rows at the left, and that the divider must be introduced by depressing the keys in the nine down rows at the right. At its right-hand end, it bears the inscription "Multiplicand," and, pitched eight down rows to the left, the inscription "Multiplier ×," indicating that one factor in a multiplication must be introduced by depressing the keys 6 in the eight down rows at one side of the key board, and the other factor must be introduced by depressing the keys in the eight down rows at the other side.

Referring now to Fig. 2, a carriage 2 comprising a pair of plates 85 is mounted to slide on a pair of parallel bars 84 in the elevated rear portion of the casing 1 and supports the shafts 74 of sixteen totalisers with number rollers 3, and with a revolution counter 4. A plate 69 is secured in the frame of the machine above the top plate 85 of the carriage and supports a value accumulator 71 whose pinions 75 can be moved into mesh with spur gears 76 at the upper ends of the totaliser shafts 74. The keys 6 operate a shift mechanism A.

2. The mechanism for controlling the connection of the value accumulator and the totalisers

Referring now to Figs. 13, 14, and 15, the lever 24 of the accumulator key 16 (S) at the right of the machine is mounted to swing about a fixed bar 25 secured in the frame of the machine. A spring 27 connected to that part of the key lever 24 which is at the front of its fulcrum 25 turns the lever clockwise and holds a projection 26 on the lever against a fixed abutment—not shown—in the normal position of the key 16. The front end of the key lever 24 has a projection 24*a* arranged to engage an abutment—not shown—and is slotted at 28 to engage a headed screw 31 at the free end of an arm 30 on the right-hand end of a shaft 29 which is mounted to turn in the frame of the machine. Another arm 32 is placed on the opposite end of the shaft 29 and pivotally connected to the front end of a rod 33 at 33*a*. The rear end of the rod is notched at 35 and is held against a hook 36 at the lower end of a T lever 37 by a spring 34 pulling the rod in the direction *b* and upwards at the same time. The T lever 37 is fulcrumed on a bracket 38*a* at 38 with its second arm. The upper end 39 of the third arm engages below an abutment—not shown—on the bracket 38*a* in its initial position, Fig. 14. A pin 40 on this third arm engages in a curved slot 41 in the lower end of a link 43 which is mounted to swing about a headed screw 42 in the frame of the machine. A bellcrank 45, 49 is mounted on the same headed screw and a spring 44 attached to the upper arm of the bellcrank at 47 and to the upper end of the link 43 at 43*a* pulls the arm against a projection 46 on the upper end of link 43.

A pin 48 at the free end of the upper arm 45 engages in a slot 83 in the free end of a crank 82 which is secured on a journal 81. This journal forms part of the accumulator 71 and is mounted to rotate in a bearing 70 on the plate 69.

The lower arm 49 of the bellcrank is crooked at its free end and defines a curved recess 50 for cooperation with a cam sector 52 which is keyed on the tens transfer shaft 51. The drive of the tens transfer shaft is illustrated in Fig. 13 at the right. The main driving shaft 145 which, as mentioned, is driven from the motor 7*a* through a worm gear—not shown—is equipped with a spur gear 146. A spur gear 147 on a shift-mechanism driving shaft 216 meshes with the spur gear 146, their direction of rotation being indicated by the arrows. A bevel gear 148 on the spur gear 147 meshes with a bevel gear 149 on the tens transfer shaft 51 which is rotated anti-clockwise.

A pin wheel 53, with a sector-shaped end plate at the left, and a fully circular end plate at the right, is mounted to turn freely on the tens transfer shaft 51 but held against axial displacement. The pin wheel 53 controls the totaliser coupling D, Fig. 2. A sleeve 57 is splined on the tens transfer shaft 51 at the right of the pin wheel 53 and supports a camplate 55 at the left, and a flange 58 at the right. In the position illustrated in Fig. 13, the camplate 55 is in the immediate vicinity of the pin wheel 53, and a coupling pin 56 on the camplate 55 projects into a hole 54 in the full end plate of the pin wheel 53. The pin wheel now rotates with the tens transfer shaft.

The sleeve 57 is shifted by a coupling lever 61 which is mounted to swing about a pin 60 in the machine frame. The position of this pin with respect to the carriage 2 is shown in Fig. 2. A fork 69 at the right-hand end of the coupling lever 61 engages the flange 58 on the sleeve 57 and a spring 64 which is attached to the coupling lever 61 at 65, turns the lever anti-clockwise so that it pushes the sleeve against the pin wheel 53. A tooth 62 on the coupling lever is arranged to engage in a notch 63 of the full pin wheel disk 53 and to hold the disk against rotation with the tens transfer shaft, but clears the notch in the coupling position illustrated in Fig. 13. The left-hand end of the coupling lever 61 is an extension 66 which under the pull of the spring 64 slides along the inclined edge of a member 67 which is fixed the machine frame, unti it is arrested by the edge 68 of the T lever 37. This is the initial position of the coupling lever.

When the accumulator key 16 is depressed for accumulating a value in the accumulator 71, its type lever 24 is swung anticlockwise until its projection 24*a* is arrested by the aforesaid abutment—not shown—the shaft 29 and its arms 30 and 32 are turned clockwise, and the rod 33 is pushed against the direction of arrow *b*. Through the notch 35 in the rod and the hook 36 on the T lever 37, the latter is swung anti-clockwise and its pin 40 acts on the edge 41[a] of the slot 41 in the link 43, turning the link anti-clockwise. The spring 44 turns the upper arm

of the bellcrank 45, 49 which, as described, is mounted to swing on the headed screw 42 with the link 43, anti-clockwise. This, through the pin 48 at the upper end of the arm 45, and the slot 83 in the crank 82, moves the accumulator 71 from its inactive position, Fig. 2, into its active position, Fig. 3.

The swinging of the upper arm 45 of the bellcrank in anti-clockwise direction moves the lower arm 49 with its recess 50 into the path of the sector 52. The T lever 37 when turned anti-clockwise raises the extension 66 of the coupling lever 61 by its edge 68 and turns the coupling lever clockwise. This causes the tooth 62 to engage in the notch 63 in the full end plate of the pin wheel 53 so that the pin wheel is now held against rotation, while at the same time the fork 59 shifts the sleeve 57 on the shaft 51 in the direction of the arrow *a* in Fig. 13. This moves the coupling pin 56 out of the hole in the full end plate of the pin wheel 53 so that the tens transfer shaft 51 rotates without being interfered with by the arrested pin disk 53. When the tens transfer shaft has turned through about two thirds of a complete revolution, its sector 52 strikes the recessed lower arm 49 of the bellcrank and turns the bellcrank clockwise against spring 44. The crank 82 is now turned anti-clockwise and moves the accumulator 71 into its inactive position, Fig. 2. This condition continues while the sector 52 slides over the recessed portion 50 of the lower bellcrank arm 49. When the sector has moved off the recess, the spring 44 returns the parts into their initial positions, Fig. 14, and the accumulator 71 is moved into active position again. When the accumulator key 16 is released, the members connected to it also return into their initial position, as shown in Fig. 14.

3. *The accumulator*

Referring now to Fig. 4, the plate 69 is secured to the frame of the machine at the rear by screws inserted in holes 69*a* in opposite ends of the plate. The bearing 70 for the journal 81 at the left has already been referred to, and a similar bearing is provided for the journal at the other end of the accumulator 71. The two bearings 70 are made with plates for securing them to the plate 69 by screws 70*a*. The accumulator shaft 70*b* is solid only at both ends where the journals are and otherwise consists of two parallel bars 72 and 73, with a milled slot between them. The outer faces of the bars are flattened, as best seen in Fig. 5. Sixteen accumulator wheels 75 are mounted to rotate on the shanks of headed screws 75*a* between the bars 72 and 73. A zero stop 78, Fig. 6, projects from the rear face of each wheel 75 and a check 79 is provided on the inner side of the rear bar 72 for cooperation with the zero stop. One tooth of each wheel 75 is cut away for half its depth to form a zero gap 80, Fig. 6. The zero stop 78 and the check 79 define the zero position of the accumulator wheels, the stop abutting against the check from above as the corresponding wheel 75 rotates in the direction of the arrow in Fig. 4. The stop and the check also prevent overthrowing of the wheels 75.

The upper portion of the plate 69 is crooked at 5, Fig. 2, and equipped with a pair of prongs 77 for each accumulator wheel 75 which in the inactive position of the accumulator, that is, when its wheels 75 are not in mesh with the corresponding spur gears 76 at the upper ends of the totaliser shafts 74, engage the two flanks of a tooth in the corresponding accumulator wheel 75 so that the wheels cannot rotate.

As described in chapter (2), depression of the accumulator key 16 causes the accumulator to move into its active position in which the wheels 75 mesh with the totaliser spur gears 76, and, when a value has been introduced in the accumulator, the accumulator returns into its inactive position in which its wheels are blocked by the prongs 77.

4. *The canceling device of the accumulator*

This device which has been illustrated in Fig. 4, is referred to as the "cancelling device" because it serves for canceling a value which has been introduced in the accumulator. But it also serves for adding a value which is introduced in the accumulator to a value which has already been introduced.

Two L-shaped brackets 86 are secured to the plate 69 by screws 86*a* near its lower edge and a canceling rack 87 is mounted to slide in the brackets. In its initial position, the rack 87 bears against a check 88 with its left-hand end, and its movement toward the right is limited by another stop 89. A canceling wheel 90 is arranged below each accumulator wheel 75 in meshing relation on a pin 91. A strip 92 holds the canceling wheels 90 on the pins 91 and is, in turn, secured by nuts 92*a* on the outer ends of some of the pins 91. By these means, the canceling wheels 90 mesh with the corresponding accumulator wheels 75 above, and with the rack 87 below. Each canceling wheel has a zero gap 93, Fig. 4, which, like the gaps 80 in the accumulator wheels 75, extends for half the depth of a tooth.

The canceling rack 87 is operatively connected to the camplate 55 on the sleeve 57 by the following mechanism: A fork 94, with a slot 95, projects downwardly from the canceling rack 87. A flange 96 which is mounted to slide on the lower slide bar 84, engages in the slot 95 and is secured to the right-hand end of a rod 97 whose other end is pivotally connected to a sector lever 100 which is fulcrumed about a headed screw 101 in the rear wall of the machine. A spring 98 attached to the rod 97 at 99 pulls the rod to the left and holds the lower end of the sector 102 on the sector lever 100 against the notched upper end of the rear arm 103 of a double-armed lever 104. This lever is secured to one end of a sleeve 107*a* which is mounted to turn on a bar 104*a* secured in the left-hand side wall of the machine. The front arm of the double-armed lever bears against a headed screw 106 with its end 105, against which it is held by gravity since the rear arm 103 is heavier than the front arm. A roller arm 107, with a roller 108 at its upper end, is held against the camplate 55 on the tens transfer shaft 51 by the weight of its arm 103.

When the accumulator 71 has been moved into its active position, Fig. 3, its wheels 75 engage with the spur gears 76 on the totaliser shafts 74 and with the canceling wheels 90 on the plate 69 and are clear of the prongs 77. At the same time, the coupling lever 61, Fig. 13, has shifted the sleeve 57 to the right in the direction of the arrow *a*, so that the camplate 55 is moved out of coupling relation to the pin wheel 53, and is presented to the roller 108 on the arm 107. When the tens transfer shaft 51 rotates anticlockwise, as indicated by the arrow in Fig. 4, the elevated portion of the camplate 55, through roller 108 and arm 107, swings the lever 104 clockwise, its arm 103 engages below the end of the sector 102

of the lever 100, and the rod 97 and the rack 87 are shifted in the direction of arrow *a*.

If there is no value in the accumulator 71, that is, if its wheels 75 are at zero, their zero gaps 80 are in line with the zero gaps 93 of the canceling wheels 90, as shown in Fig. 3, so that the rotation of the canceling wheels in anti-clockwise direction, Fig. 4, does not influence the accumulator wheels 75. On the other hand, if a value has been introduced in the accumulator 71, solid teeth of the accumulator wheels 75 are in line with the zero gaps 93 of the canceling wheels, and so the canceling wheels rotate the accumulator wheels until the zero gaps 80 in the accumulator wheels 75 are again in line with the zero gaps 93 of the canceling wheels 90. At the same time, the zero stops 78 of the accumulator wheels are arrested by the checks 79, and overthrowing is prevented. Since the accumulator wheels 75 mesh with the spur gears 76 at the upper ends of the totaliser shafts 74, Fig. 3, the shafts are rotated clockwise, as indicated by the arrow *y*, and the value which has been accumulated in the accumulator 71, is added to the value already present in the corresponding totaliser. At this moment, the highest point of the camplate 55 is on the roller 108, and, as the tens transfer shaft 51 continues its rotation and the descending portion of the camplate 55 comes to act on the roller 108, the rack 87 is allowed to return into its initial position against the check 88 at the left under the action of the spring 98.

5. *The locking and coupling means for the accumulator key*

The functions required for the accumulation of a value necessitate a complete revolution of the tens transfer shaft 51, and the following mechanism is provided for performing this: Referring to Fig. 10, an arm 109 is keyed on the shaft 29 and a rod 110 is pivotally connected to the free end of the arm. At its rear end, the rod is equipped with a lug 111 which is arrested by a recessed intermediate partition 112. A headed screw 113 at the rear end of the rod 110 guides the rod in a slot in the partition 112 and a catch 115 is mounted to swing about the headed screw. A spring 117 whose upper end is secured to the partition 112, holds a lug 116 extending at right angles from the catch 115, against a curved face 118 of the partition 112.

A step 119 is arranged on the rear end of the catch 115 which is arranged to cooperate with a lug 120 of a bellcrank 121 which lug, however, in the inactive position of the mechanism engages in a recess 122 in the catch 115. The bellcrank 121 and another bellcrank 123 are mounted to swing about a headed screw 125 in a lever 126 having a curved slot 138. The slotted lever 126 is mounted to swing about a bar 127—see also Fig. 10*a*—arranged in the machine frame. When the bellcrank 121 is swung, the levers 123 and 126 which are connected to the bellcrank, swing anti-clockwise about the bar 127. A headed screw 128 in the slotted lever 126 engages in a curved slot 129 of the bellcrank 121. The bellcrank is thus enabled to perform a limited swinging movement independently of the slotted lever 126. A spring 130 secured to a pin 123*a* of the bellcrank 123 at one end, and to a pin 126*d* of the slotted lever 126 at the other end, tends to turn the bellcrank 123 anti-clockwise, the initial position of the bellcrank 123 being determined by a lug 132 engaging the bellcrank 121. The bellcrank 121 is pulled with the right-hand end 131 of the slot 129 against a headed screw 128 by a spring 129*b* anchored in the machine frame and attached to the pin 129*a* of the bellcrank 121, with the levers 121 and 126 making up a single unit so that the lever 126 is turned anti-clockwise by the spring 129*b* about the bar 127, its initial position being defined by its edge 126*a* engaging an abutment 133 in the machine frame, Fig. 10.

The arm 134 of the bellcrank 123 is also able to cooperate with the abutment 133, the arm 134 being above the abutment 133 in the initial position of the mechanism.

Two tens transfer cams 135 on the tens transfer shaft 51 are connected by a stay 136 and this stay is in the path of an extension 137 of the bellcrank 121.

The bellcrank 126, Fig. 10*a*, has shoulders 126*a* and 126*b* at the sides of its curved slot 138, and these cooperate with a pin 139, Fig. 10, at the free end of an arm 141 on a shaft 140 mounted to rotate in the frame of the machine. At its right-hand end, the shaft 140 supports a coupling arm 142 which controls the shift mechanism coupling 143 and the carriage control coupling 114 on the main driving shaft 145. The shift mechanism coupling 143 effects a complete revolution of the tens transfer shaft 51 through the gearing 146 etc. illustrated in Fig. 13. In its normal position, the pin 139 at the end of the arm 141 occupies the position illustrated in Fig. 11 with respect to the slotted lever 126 in which the lower edge of the pin 139 is in line with the shoulder 126*a*, and its left edge is below, and in front of, the right-hand edge of the shoulder 126*b*. The arc described by the pin 139 is so determined that the pin, when the pawl 144*a* of the carriage control coupling 144 is released for one step in the feed of the carriage, that is, upon oscillation in clockwise direction, engages before the shoulder 126*a* of the slotted lever 126 and locks the accumulator key 16 since the pin does not permit swinging of the slotted lever 126 anti-clockwise. The pin 139 also locks the accumulator key 16 when the pawl 143*a* of the shift mechanism coupling 143 has been released for a calculating operation by turning the shaft 140, and the arm 141, anti-clockwise, since the pin 138 engages before the shoulder 126*b*.

The operation of this mechanism is as follows: When the accumulator key 16 is depressed, the shaft 29 and its arm 109 are turned clockwise. The arm 109 shifts the rod 110 in the direction of the arrow *c*. The catch 115 which is fulcrumed to the rod 110 is turned slightly about the screw 113 anti-clockwise against the spring 117 by its lug 116 sliding along the curved edge 118. As the slot in the catch 115 engages the lug 120 of the bellcrank 121, the bellcrank is also pulled in the direction of the arrow *c*. The three levers 121, 123, and 126 are swung anti-clockwise about the bar together against the spring 129*b*. The arm 134 strikes the abutment 133 and is swung slightly about the screw 125 in clockwise direction by the spring 130 engaging its lug 132. Immediately after, when the bellcrank 123 has cleared the abutment 133, it is turned anti-clockwise by the spring 130, as shown in Fig. 12, engaging in front of the abutment 133, by which means the accumulator key 16, if released prematurely, is held in its depressed position and the entire mechanism is locked in its active condition.

During the swinging of the lever 126, the pin 139 on the arm 141 slides along the inclined edge

126*a* and up in the slot 136 of the lever 126 by which the shaft 140 is turned anti-clockwise. The clutching lever 143 releases the pawl 143*a* of the shift mechanism coupling and the coupling is thrown in.

Through mechanism which is known in the art and has not been illustrated, the circuit of the motor 7*a* is closed when the accumulator key 16 is depressed and the main driving shaft 145 is rotated anti-clockwise, as viewed in Fig. 13. When the pawl 143*a* is released the coupling 143 is connected to the main driving shaft and the tens transfer shaft 51 is rotated by the means described and illustrated in Fig. 13. As the tens transfer shaft 51 must perform only a single revolution during the accumulating operation, the clutch 143 must be disconnected after the first revolution. A short time before the tens transfer shaft 51 has completed its first revolution, the stay 136 of the tens transfer cams 135 strikes the edge 137 of the lever 121 and swings this clockwise for about the amount permitted by the slot 129. The lug 120 of the lever 121 now leaves the recess 122 in the catch 115. The lever 121 engages the lug of the bellcrank 123 and swings this clockwise against the spring 130 and its arm 134 leaves the abutment 133. When the pin 136 is on the highest point of the arm 137 of the lever 121, spring 129*b* swings the three levers 121, 123, and 126 clockwise until the lug 120 of the lever 121 engages the step 119 of the catch 115, Fig. 12*a*, but the catch and the levers 109 and 110 remain in active position under the action of locking means 168, 170, and 171, Fig. 7, as will be described in connection with the coupling means for the cancelling members of the result totalisers. By the swinging motion of the lever 126 the pin 139 slides out of the slot 138 of the lever 126, turning the coupling lever clockwise so that it returns into the path of the pawl 143*a* of the shift mechanism coupling 143 and throws this out after one revolution of the tens transfer shaft 51. When the locking of the accumulator key 16 by the means 168, 170, and 171 is released, the spring 27 at the key lever 124 returns the parts 109, 110, and 115 into their initial positions, Fig. 11, as determined by the lug 111 of the rod 110 engaging the intermediate wall 112, and spring 129*b* returns the levers 121, 123, and 126 into their initial positions.

If the operator holds the accumulator key 16 depressed after the accumulation has been completed, no calculating operations will be performed, since the arm 141 is between the shoulders 126*a* and 126*b* of the lever 126 with its pin 139, and in its inactive position.

6. The uncoupling mechanism for the revolution counters

The revolution counters 4 must not be operated when the accumulator key 16 is depressed. The rod 110 has a hole 150, as best seen in Fig. 10, and in this engages a pin 153 at the free end of an arm 154 whose boss 155 is keyed on a shaft 156. The pin 153 is arranged to slide along an incline 151 forming part of the hole 150. At the right-hand end of the shaft 156, another arm 157 is arranged whose pin 158 engages in a slot 159 in a push rod 162 which slides on a guide, not shown, with a pair of lugs 160. The crooked end 163 of the push rod is pivoted to a bellcrank 164 which is fulcrumed about a headed screw 165 and engages between a pair of flanges 166 on a control slide 167 which operates the reversing mechanism, not shown, of the revolution counters 4.

When the accumulator key 16 is depressed, the rod 110 is shifted in the direction of the arrow c and the pin 153 slides along the incline 151 and engages in a slot 152. The shaft 156 is turned anti-clockwise and the push rod 162 is moved into the position Fig. 12. The control slide 167 now assumes an intermediate position and throws out the reversing mechanisms for the revolution counters 4.

7. The coupling means for the canceling members of the result totalisers

When a value is to be accumulated the corresponding totaliser 3 must be canceled. A pin 168 on the key lever 24 of the accumulator key 24, Fig. 7, is arranged to slide along the convex edge 169 of a lever 170 and to engage in a notch 171 at the lower end of the edge. The lever is mounted to swing about a headed screw 173 in a bracket 172 at the right-hand side plate of the machine and a spring 174 pulls the lever anti-clockwise against the pin 168. A lug 176 on a U-shaped frame 177 projects into a slot 175 in the lever 170. The frame is mounted to swing about, and to slide on, a bar 180 secured in two eyes 178 and 179 of the bracket 172. The base plate 177 of the U frame which faces the operator is equipped with an arm 181. The lower edge of the arm engages a pin 182 forming a part of a second frame 184 mounted to swing about a bar 183. A hook 185, 186 on the second frame engages below a connecting rod 187. A spring 188 is connected to the lower end 186 of the hook and to a pin 189 on the connecting rod, pulling the end against an abutment 190 on the rod. Another spring 191 pushes the connecting rod 187 in the direction of the arrow *c*. A slot 192 in the front end of the connecting rod engages a pin 194 at the lower end of the key lever 193 of the totaliser cancellation key 12. In its upper final position, the key lever 193 bears against an abutment, not shown, with a projection 193*a*.

The rear end of the rod 187 is pivotally connected to a lever 194 which is mounted to swing about a bar 195. The lever has a projection 198 and a slot 196 below the projection, and a crooked extension 197 of the coupling lever 142 is normally before the slot 196. A lug 199 of the lever 194 controls the coupling lever 200 of a canceling coupling 203. The lever 200 is fulcrumed about a headed screw 201 and its arm 202 cooperates with a pawl 204 on the coupling. A canceling rod 206 is pivoted to the coupling 203 at 205 which, through rack L, pinion L_1, and spur gear L_3, Fig. 2, effects the cancellation of the result totalisers 3.

The pin 205 where the rod 206 is connected to the coupling 203, cooperates with the end 207 of a lever 209 which is pivoted about a headed screw 208 in the bracket 172. The lever 209 which is guided in a notch 211, engages the rear shank 213 of the U frame 177 with a fork 212. The shank 213 has a curved cam 214 arranged to cooperate with a cam 215 on the shaft 216, Figs. 8 and 9.

The lever 170 which is connected to the frame 177 by the pin-and-slot connection 175, 176, has a tooth 217 at its upper end for cooperation with a catch 218*a* at the free end of a spring 219 to which the catch is riveted at 218. A lug 220 on the spring is arranged to cooperate with the key lever 24 of the accumulator key 16.

When the key is depressed for the distance de-

termined by its projection 24a, its pin 168 enters the notch 171 in the lever 170 and the inner edge 171a of the notch is held against the pin by the spring 174. The movement of the lever 170 in anti-clockwise direction shifts the frame 177 to the left from the position Fig. 8 into that in Fig. 9, through slot 175 and pin 176, and the cam 214 is now presented to the cam 215. The fork 212 moves the lever 209 into its active position, Fig. 9, and its end 207 moves into the path of the pin 215 on the canceling coupling 203. As described, this coupling is turned for a complete revolution, and the shaft 216 is rotated clockwise. When this shaft has performed about three quarters of a revolution, the cam 215 engages the curved cam 214 and swings the frame 177 anti-clockwise. The arm 181 turns the second frame 184 anti-clockwise through pin 182 against the spring 188. This spring is stronger than the spring 191 and pulls the connecting rod 187 in the direction of arrow c until the projection 198 on the lever 194 bears against the extension 197 and turns the coupling lever 142 anti-clockwise. The hook 186 of the second frame now releases the shoulder 190 of the connecting rod 187, and tension is put on the spring 188. When the lever 194 returns from its active position, Fig. 12, into its initial position, Fig. 11, a short time before the tens transfer shaft 51 has completed its revolution, the extension 197 of the coupling lever 142 releases the projection 198, so that now the connecting rod 187 is free to move in the direction of the arrow c under the pull of spring 188 until its shoulder 190 is intercepted by the end 186 of the hook 185. The lever 194 is swung anti-clockwise and its arm 199 turns the lever 200, so that the pawl 204 of the canceling coupling is released and the coupling is connected to the main driving shaft 145. At this moment the shift mechanism coupling 143 and the shaft 216 have turned so far that the cam 215 releases the cam 214, so that the spring 191 returns the frame 177, the frame 184, the rod 187, the lever 194, and the lever 200 into their initial positions.

The canceling coupling 203 rotates anti-clockwise and, through L, L_1, and L_3 (the pinion L_1 rotating in the direction of arrow x, Fig. 2) cancels the corresponding totaliser 3. Before the canceling coupling 203 has completed the first half of its revolution, its pin 205 acts against the end 207 of the lever 209 from below and the lever is turned about the screw 209 clockwise. This movement is transmitted to the lever 170 through fork 212 and the parts connected to it, and the lever now turns clockwise. Its upper end 217, Figs. 8 and 9, acts against an incline on the catch 218a and forces the catch up. When the end of the lever 170 is in the position shown in dot-and-dash lines in Fig. 9, the catch 218a engages over the end 217 and the lever 170 is held against return in anti-clockwise direction.

When the corresponding result totaliser 3 has been canceled all functions required for accumulation have been performed, and the accumulator key 16 can now be released. The lever 170 when turning clockwise as described, releases the pin 168 of the accumulator key 24 which was in the notch 171, allowing springs 27 and 34 to return all parts connected to the key lever, to return into their initial positions. However, before the key lever 24 reaches its upper final, or initial position, it bears against the lug 220 and raises the catch 218a so that the lever 170 is released and the spring 174 pulls it against the pin 168 on the key lever 24, Fig. 8.

If the operator holds the accumulator key 16 depressed after the accumulation has been completed, no calculations can be performed for the reasons stated in the last paragraph of chapter (5). On the other hand, the catch 218a allows the key lever 24 of the accumulator key 16, and the parts connected to it, to return into their initial positions immediately when the key 16 is released.

8. Mechanism for canceling the accumulator

The bar 221 of the accumulator cancelation key 17, Fig. 7, is curved and has a slot 222 at its lower end with which it is guided on a headed screw 223. A spring 224 pulls the bar up in the direction of the arrow d in Fig. 17. The bar 221 has a lug 225 with an angular tooth 226. The lower edge of the tooth bears against the pin 168 on the key lever 24 and its concave front edge 227 co-operates with the convex edge 169 of the lever 170.

When the accumulator cancelation key 17 is depressed, its tooth 226 turns the key lever 24 of the accumulator key anti-clockwise through the pin 168. The length of the slot 222 is so determined that the final position of the key 17 is also the active position of the accumulator key 16, as shown in Fig. 17. The mechanisms connected to the accumulator key 16 are now operated as described, and the accumulator is canceled by transferring the accumulated values to the result totalisers 3. The totalisers 3 cannot be canceled by the means described in Chapter 7 as the lever 170, notwithstanding the juxtaposition of its notch 171 and the pin 168, cannot turn under the pull of the spring 174 because it is arrested by the concave edge 227 of the tooth 226 engaging its convex edge 169.

9. The operation of the machine

Assume that the products 11×11, 12×16, and 13×15 are to be added, and that the product 25×5 is to be subtracted from the total of the three products. The result totalisers 3 and the accumulator 71 are in their zero positions.

The calculation keys 6 are depressed in the seventh and eighth down rows from the left, Fig. 1, for introducing the multiplier 11, and the multiplicand is introduced in a similar manner at the right, the multiplication key 18 is depressed, and the first product 11×11=121 is indicated by the corresponding result totaliser 3, the revolution counter 4 indicating "11." The first product, 121, must now be transferred to the accumulator 71 by depression of the accumulator key 16. Shaft 29 is turned clockwise and the parts 32, etc., are moved from their initial positions, Fig. 14, into the active positions, Fig. 15, as described. The end 50 of the lower arm 49 of the bellcrank 45, 49 is presented to the sector 52 on the tens transfer shaft 51, the pin disk 53 for the totaliser coupling D is disconnected from the transfer shaft 51 by the lever 61 shifting the sleeve 57 in the direction a, Fig. 13, and moving the camplate 55 into active relation to the roller 108 at the upper end of the roller arm 107, Fig. 4. At the same time, the accumulator 71 is moved into its active position, as shown in Fig. 15, so that its wheels 75 mesh with the totaliser spur gears 76, Fig. 3, and, if the number rollers of the totalisers 3 are returned to zero, the first product 121 is transferred to the accumulator 71 by the totaliser 3.

Upon depression of the accumulator key 16, the parts 109, etc., are moved from the position

in Fig. 11 into that in Fig. 12, and the same occurs with the parts 153, etc., connected to the shaft 156, by which means the totaliser 4 is rendered inactive.

Lastly, the pin 168 on the key lever 24 of the accumulator key 16, through lever 170, moves the frame 177 from the inactive, or initial, position, Fig. 8, into the active position Fig. 9, in which the curved cam 214 of the frame is presented to the cam 215 on the shaft 216, and the end of the lever 209 is presented to the pin 205 of the canceling coupling 203.

When the said preliminary adjustments subsequent upon the depression of the accumulator key 16 have been completed, as described, the circuit of the motor 7*a* is closed by automatic means, not shown, and the main driving shaft 145 is rotated anti-clockwise. The shift mechanism coupling 143 which has been thrown in by its lever 142, rotates with the main driving shaft and the tens transfer shaft 51 is rotated through the gearing which has been described. The first operation performed by the rotating tens transfer shaft is the cancelation of the accumulator 71 by the elevated portion of the cam plate 55 depressing the roller 108 on the arm 107 and, through the means described, shifting the rack 87, Fig. 4, to the right so that the canceling wheels 90 are rotated anti-clockwise. However, as there is as yet no value in the accumulator wheels 75, their zero gaps 80 are presented to the canceling wheels 90 and they do not rotate the accumulator wheels 75.

When the canceling operation in the accumulator 71 has been completed, that is, when the roller 108 is engaged by the lower portions of the camplate 55, which occurs after about two thirds of a revolution of the tens transfer shaft 51, as described, the sector 52 engages the lower arm 49 of the bellcrank whose upper arm moves the accumulator 71 into inactive position by means of the crank 82. In the present instance, this disconnection of the accumulator wheels 75 and the totalizer spur gears 76 has no function. When the sector 52 releases the arm 49, the spring 46 returns the bellcrank 45, 49 into the position shown in Fig. 15 in which the accumulator 71 is returned into active position and its wheels 75 reengaged with the totalizer spur gears 76. At this moment, the cam 215 on the shaft 216 engages the cam 214 of the U frame 177 and tension is put on the spring 188, as described.

Shortly before the tens transfer shaft 51 has completed its revolution, the stay 136 of the tens transfer cams 135 engages the arm 137 of the lever 121 and turns the lever clockwise, so that, as described, the arm 134 of the lever 123 again leaves the abutment 133, and the spring 129*b* swings the levers 121, 123, and 126 until the lug 120 engages the step 119 in the catch 115, the parts occupying the intermediate positions illustrated in Fig. 12*a*. At the same time and under the action of the slot 138 in the lever 126, the coupling lever 142 returns into its initial position in which it throws out the shift mechanism coupling 143 after one revolution, and releases the lever 194, as described, so that it couples the canceling coupling 203 with the main driving shaft 145 under the pull of the spring 188, by the means described.

Since the accumulator key is still locked in its depressed position and holds the accumulator 71 in active position, the accumulator wheels 75 still are in mesh with the totalizer spur gears 76. The rod 206 which is connected to the canceling coupling 203 at 205, cancels the totalizer 3 which contains the first product 121 through members L_1, L, and L_3 in the manner described, the accumulator wheel 75 being rotated for the amount introduced into the totalizer during the first half revolution of the canceling coupling 203. The totalizer shaft is rotated clockwise until its tens transfer cam N, Fig. 2, engages the tooth Z*a* of the tens transfer slide Z. Thus, the accumulator 71 receives the first product 121 while the corresponding result totaliser 3 is returned to zero. After in this manner the value 121 has been transferred into the accumulator 71 from the totaliser 3, the accumulator key 16 is unlocked by the pin 205 of the canceling coupling 203 engaging the end of the lever 209, and all parts operated by the accumulator key 16 return into their initial positions. The factor "11" which is still in the revolution counter 4, is canceled by depressing the key 13.

The second product, 12×16, is now introduced by means of the keys 6, as described, and the multiplication key 18 is depressed whereupon the value 192 is indicated by the totalizer 3, and the value 6 by the revolution counter. To obtain the total 121 + 192, the accumulator key 16 is depressed again, but the product 192 is not transferred to the product 121 already in the accumulator 71 but the product 121 in the accumualtor 71 is added to the product 192 in the totalizer 3 by canceling the accumulator 71 and the total 313 thus obtained in the totalizer 3 is transferred to the accumulator 71.

When the accumulator key 16 is depressed, the accumulator 71 is canceled in the manner described above, its canceling wheels 90 rotating anti-clockwise. This, however, applies only to the three wheels 75 at the right, as the value 121 was introduced only in these by the first accumulation and so a solid tooth of the three wheels is in line with the zero gaps 93 of the allotted canceling wheels 90. These wheels 75 are now rotated clockwise until their zero stops 78 engage the checks 79. By the rotation of the three wheels 75 at the right, the three totalizers 3 at the right are rotated anti-clockwise through spur gears 76, in conformity with the accumulated value 121. However, since the totalisers already indicate the value 192, the accumulated value 121 is added to 192, but only "213" is indicated by the totalisers, since the tens transfer has only been prepared for the present since the tens transfer cam N of the spur gear N*a*, Fig. 2, engages the tooth Z*a* of the tens transfer slide Z and shifts the slide in the direction of the arrow *b*. At this moment, the tens transfer shaft 51 has been rotated so far that its sector 52 acts on the end 50 of the bellcrank arm 49 and thereby disconnects the accumulator 71 from the gear wheels 76. This is necessary for the tens transfer, because the accumulator wheels 75 which are already at zero could not rotate clockwise as required for tens transfer, being arrested by the checks 79. The tens transfer is effected immediately after the accumulator has occupied its inactive position, Fig. 2, in manner per se known, by the tens transfer cams 135 on the tens transfer shaft 51 which elevate all tens transfer slides M. As, however, only the tens transfer slide Z of the tens place was shifted in the direction *b*, the corresponding tens transfer slide M is turned to the right when the slide Z rises, turning the number roller of the 100 place of the totalizer for one place so that now the correct amount 313 is now indicated by the totalizers. After this has been effected, the

sector **52** releases the arm **49**, and the spring **44** returns the accumulator into active position.

When the tens transfer shaft **51** has completed its revolution, the shift mechanism clutch **143** is thrown out and the canceling coupling **203** is thrown in, so that the totalizers are now canceled. As the value accumulator is still in the active position, Fig. 3, the total of the two products $121+192=313$, is transferred to the value accumlator **71**. The third product $13\times15=195$ is now introduced and appears in the totalizers. For adding the value 313 in the accumulator **71** to the value 195 in the totalizers, the accumulator key **16** is depressed again, and the product 195 is now transferred to the accumulator **71** in the manner described. The value 508 is now in the accumulator **71**. The product 25×5 must now be subtracted from the total 508. The handle **21**, Fig. 1, is placed on "division", or negative multiplication. The two factors 25×5 are now introduced by means of the keys in the manner described and the multiplication key **18** is depressed. The product now appears negative, 999 999 999 999 9875. To find the final result, $508-125=383$, the accumulator cancelation key **17** is depressed and thereby the value 508 in the accumulator **71** is transferred additively to the value in the totalizers, and the machine now performs the following calculation:

$$
\begin{array}{r}
999\ 999\ 999\ 999\ 9875 \\
+\ 000\ 000\ 000\ 000\ 0508 \\
\hline
000\ 000\ 000\ 000\ 0383
\end{array}
$$

The value "1" found at the left of the sixteenth place, by tens transfer, is not indicated since there is no number roller at this point, and so the correct result 383 is indicated by the totalizers.

To cancel the value 383 from the totalizers, the totalizer cancelation key **12** is depressed, the cancelation coupling **203** is thrown in and the value 383 is canceled from the totalizers through the mechanism L, L_1, L_3. The accumulator and the totalizers are now at zero again.

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RICHARD GRÖSCHEL.

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MAY 25, 1943.	CALCULATING MACHINE	219,078
BY A. P. C.	Filed July 13, 1938	11 Sheets-Sheet 1

Fig. 1

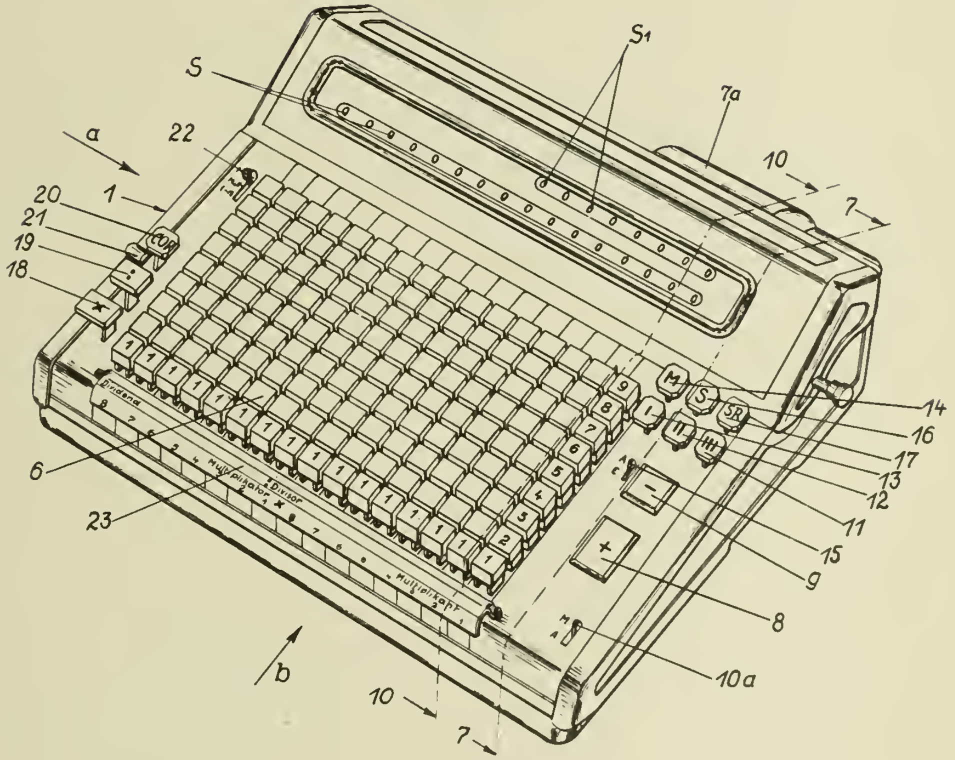

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Fig. 2

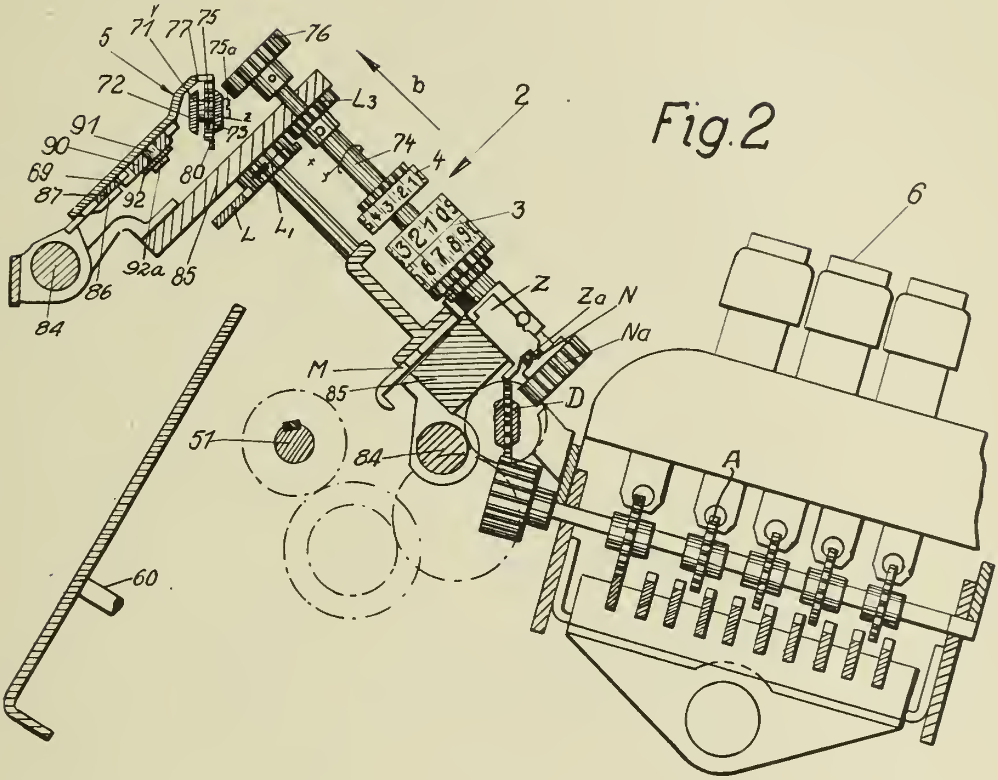
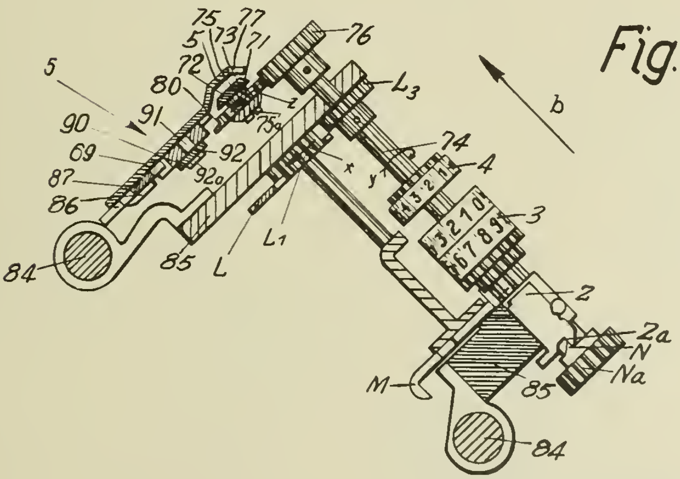


Fig. 3



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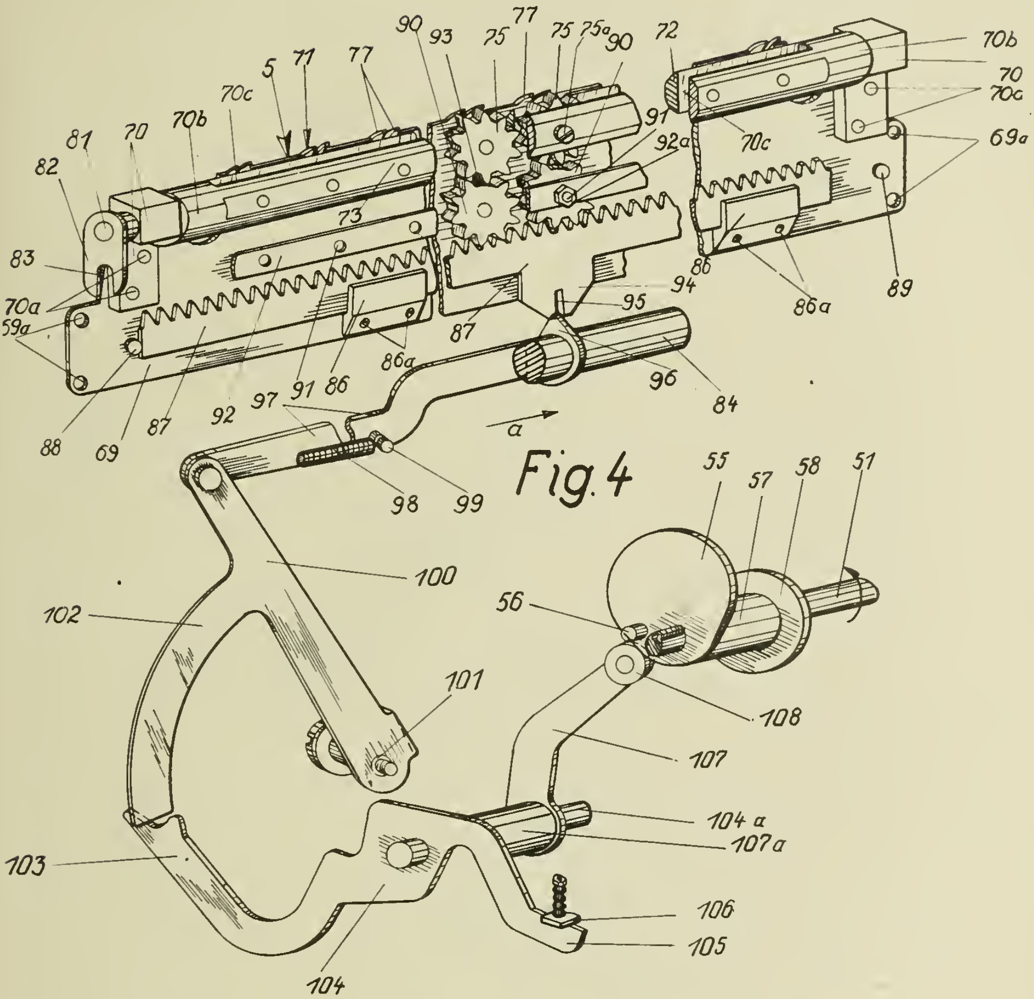


Fig. 4

Fig. 5

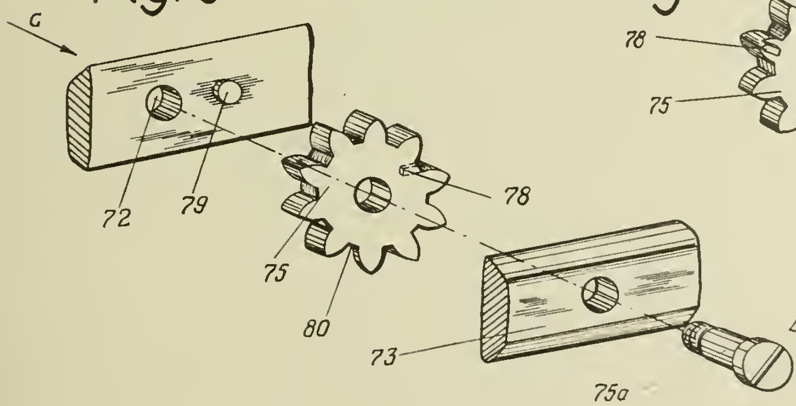
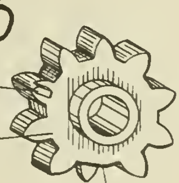


Fig. 6



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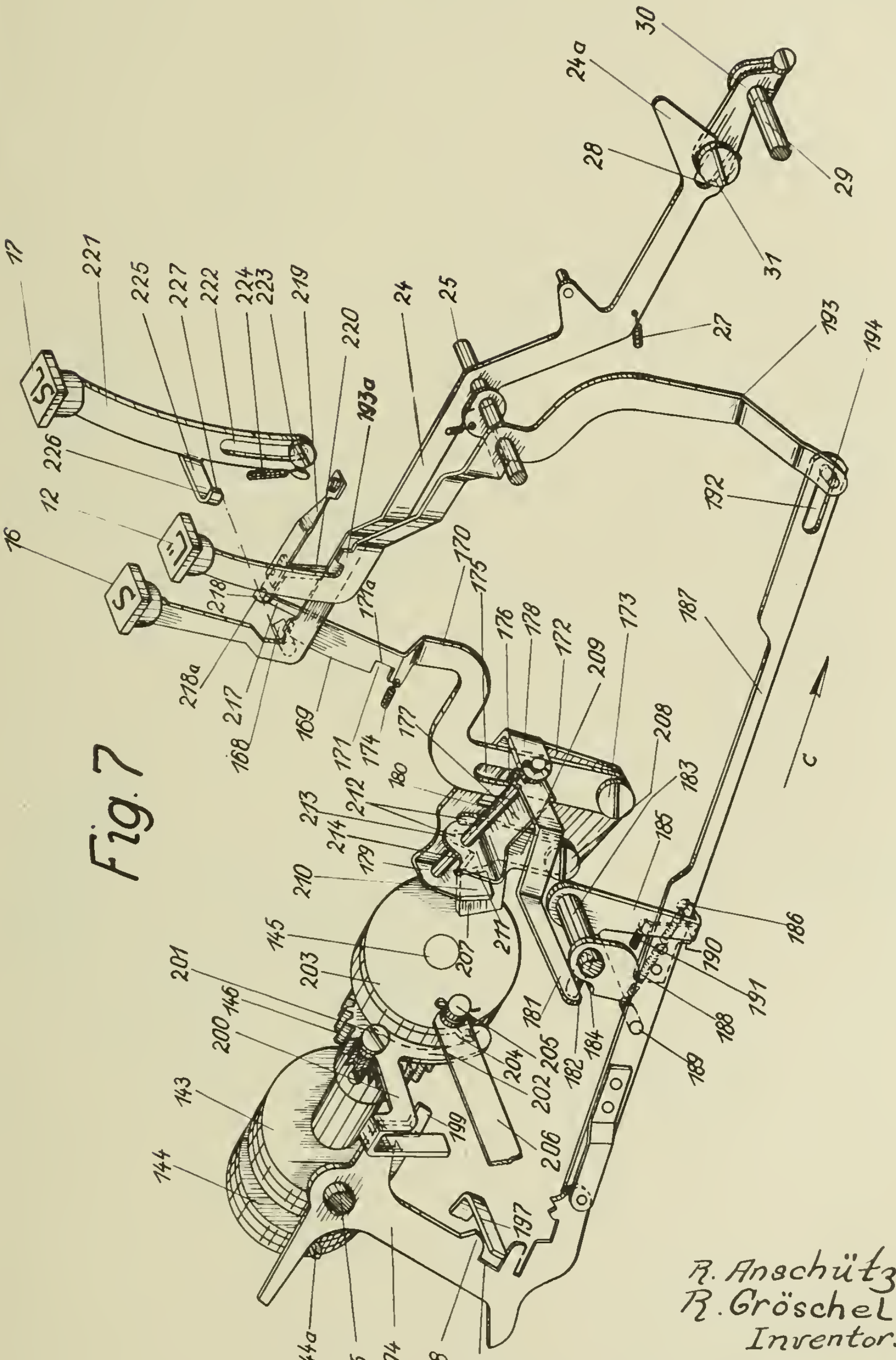

Fig. 7

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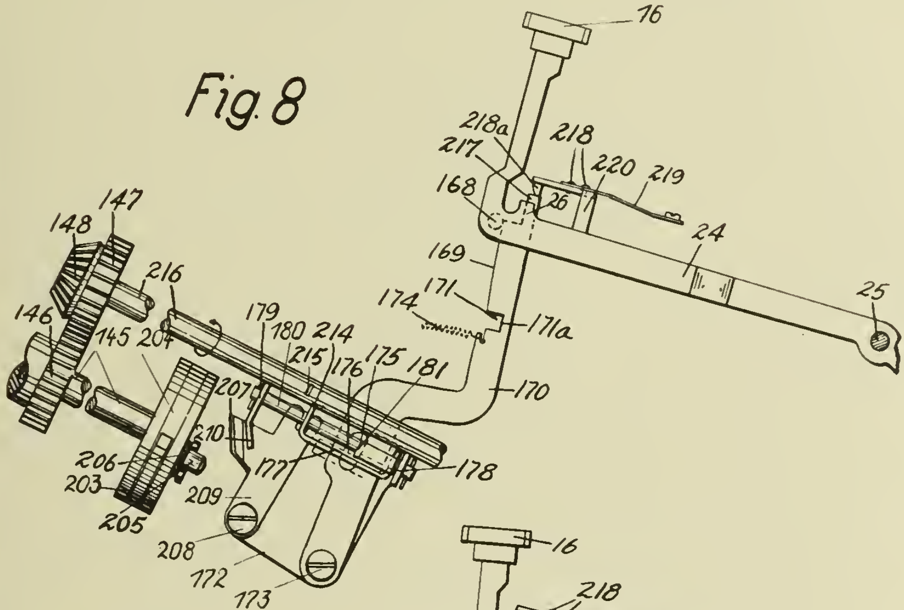
Fig. 8



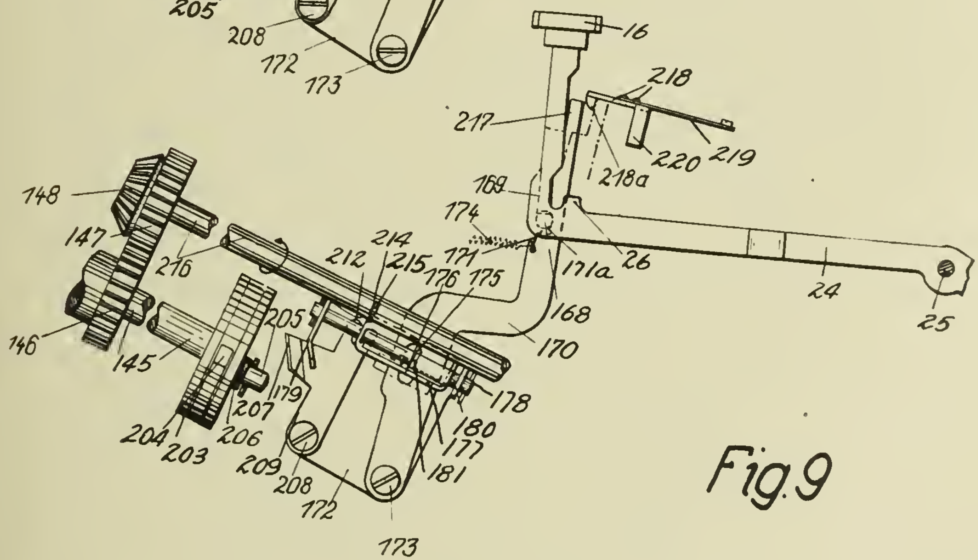


Fig. 9

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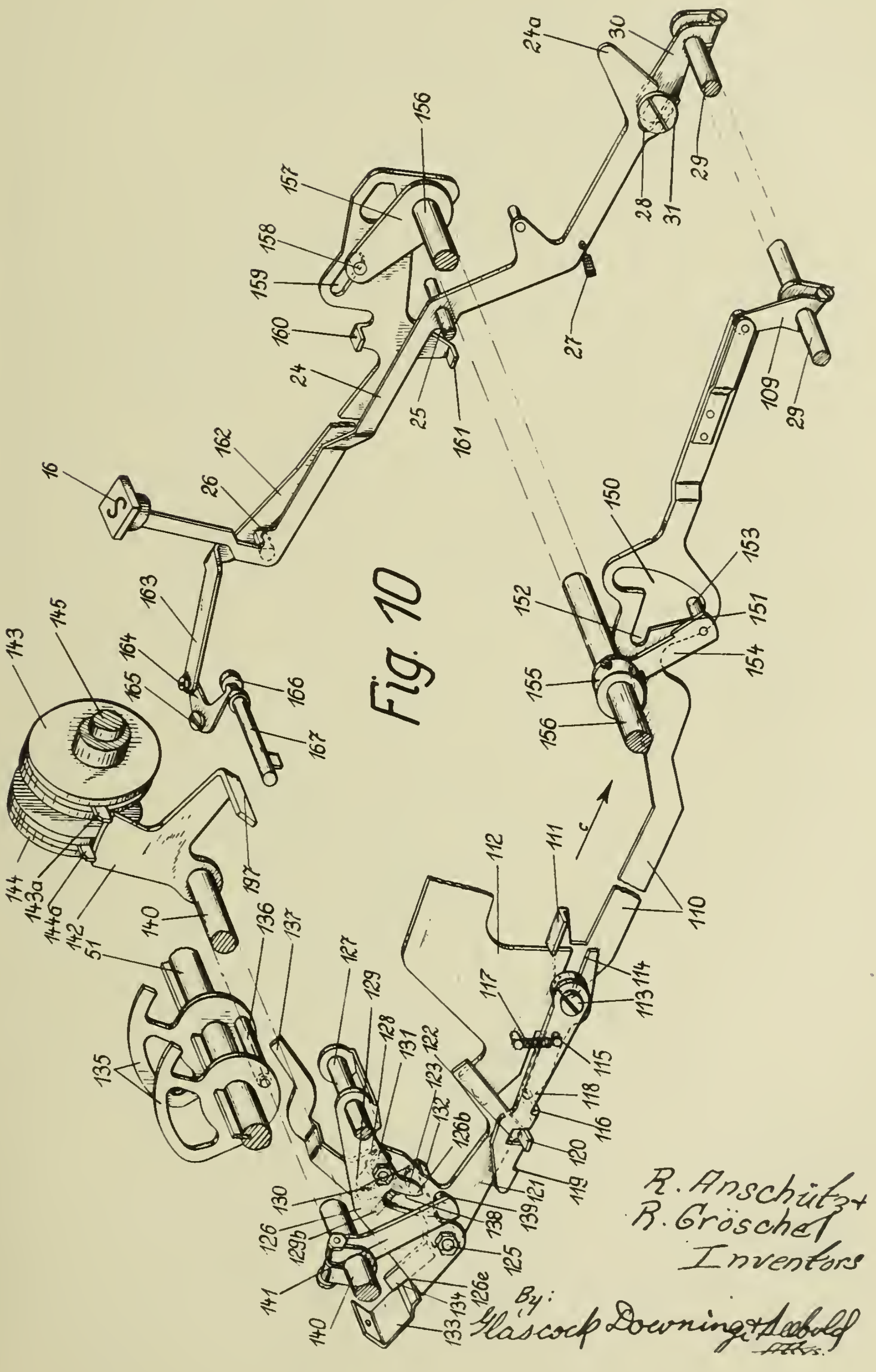

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Fig. 10a

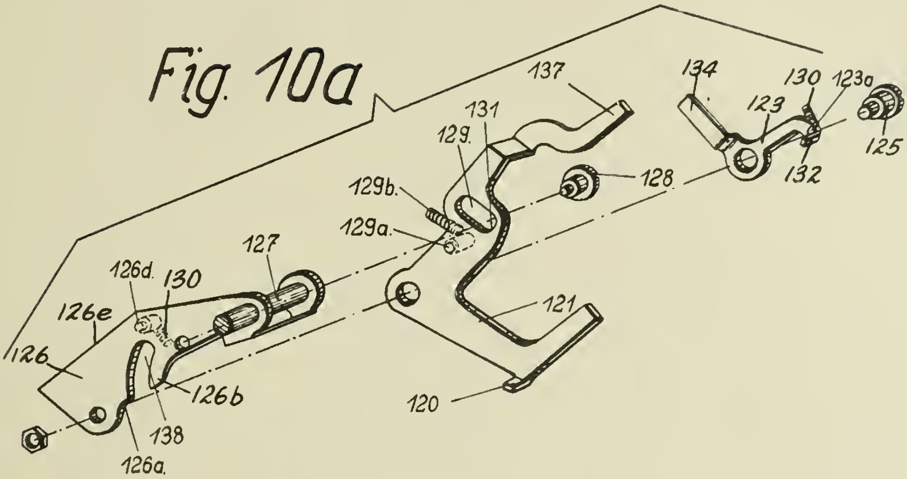
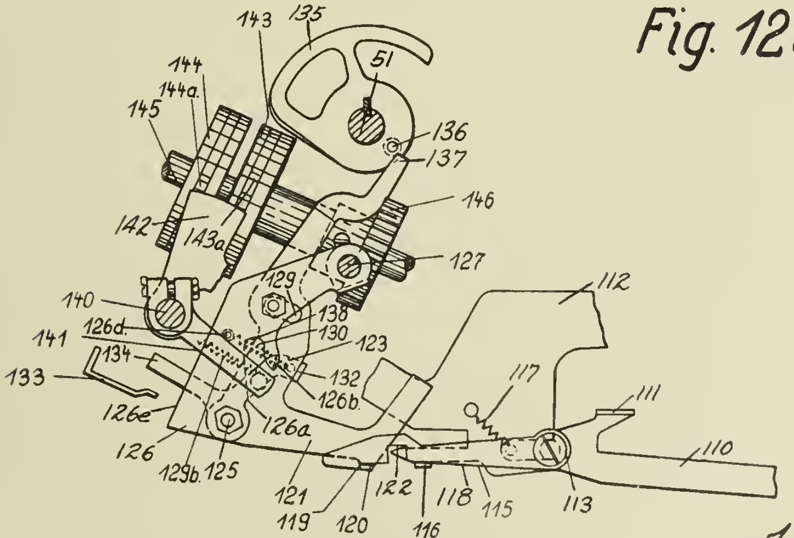


Fig. 12a



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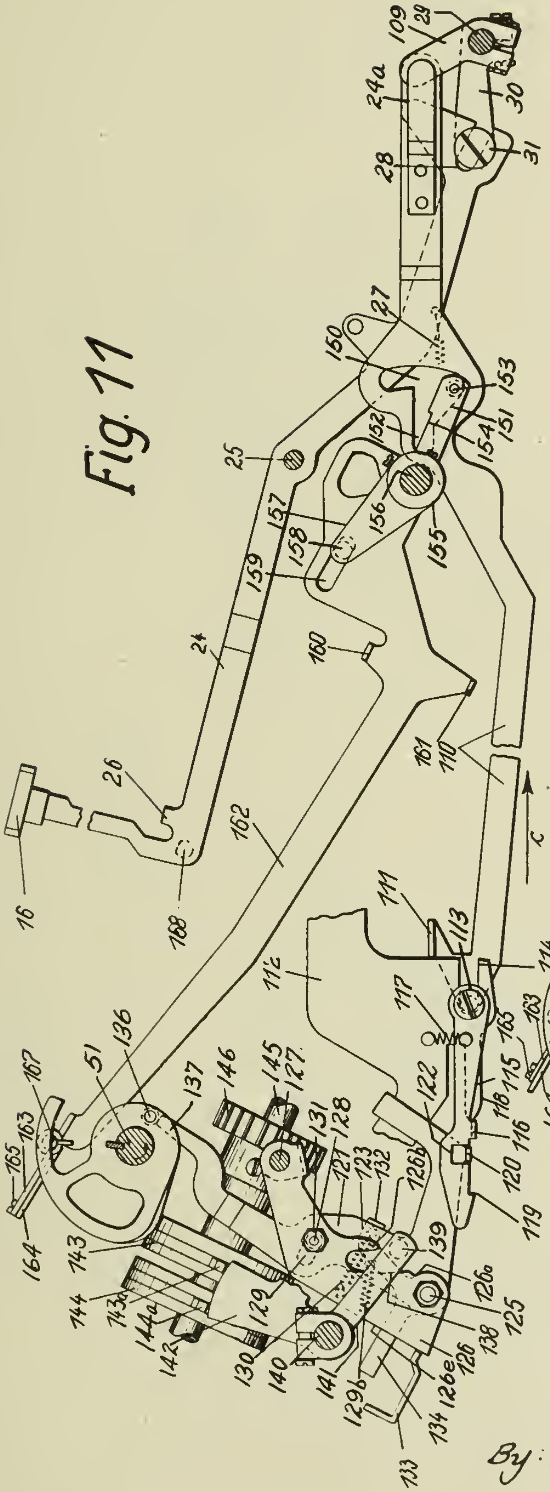

Fig. 11

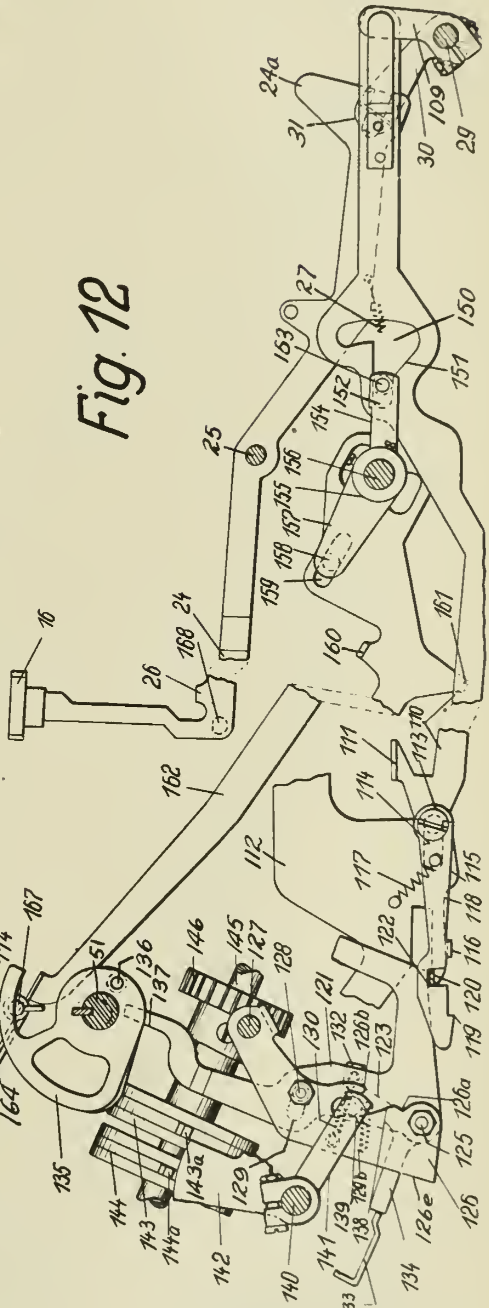

Fig. 12

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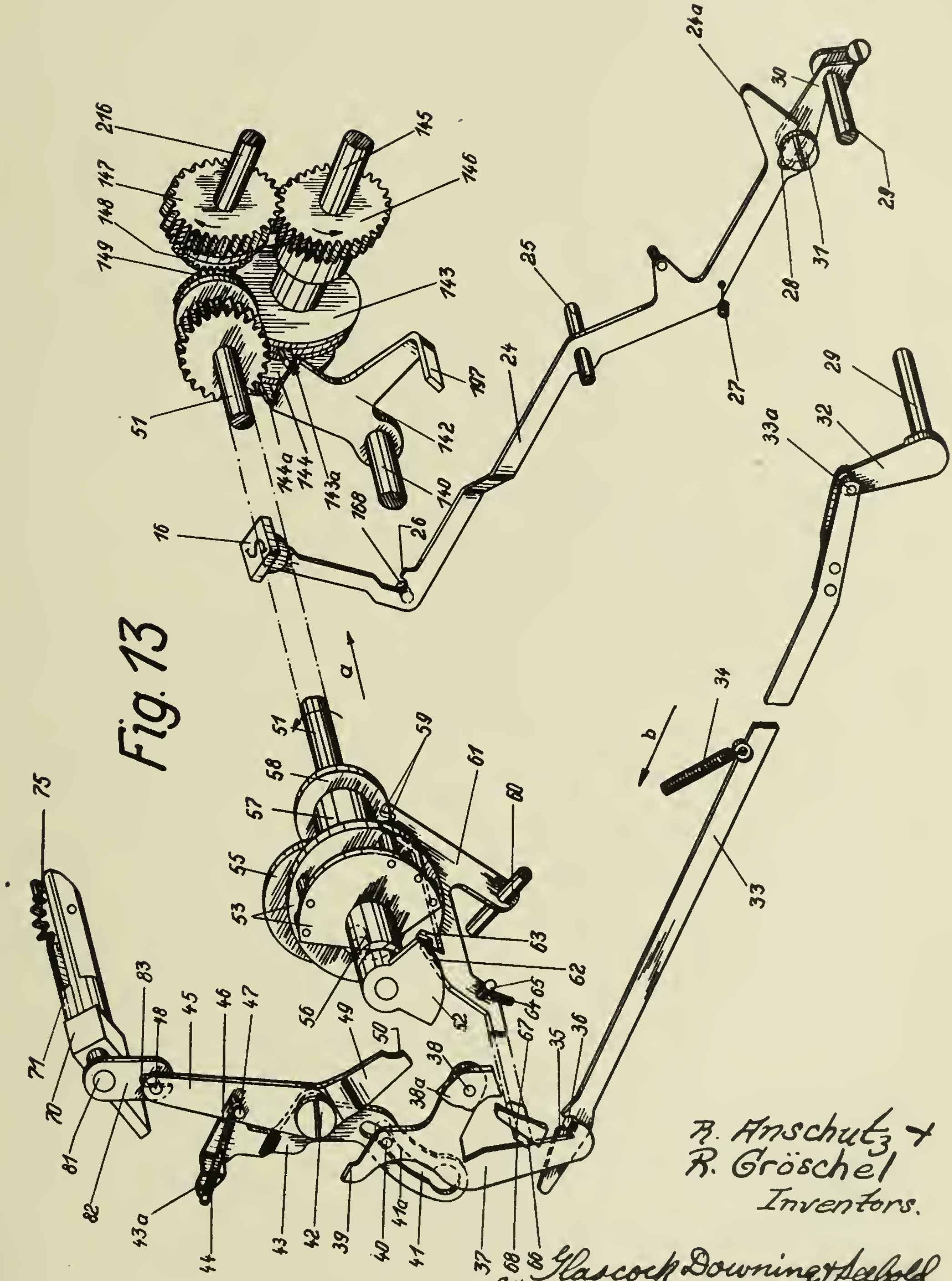

Fig. 13

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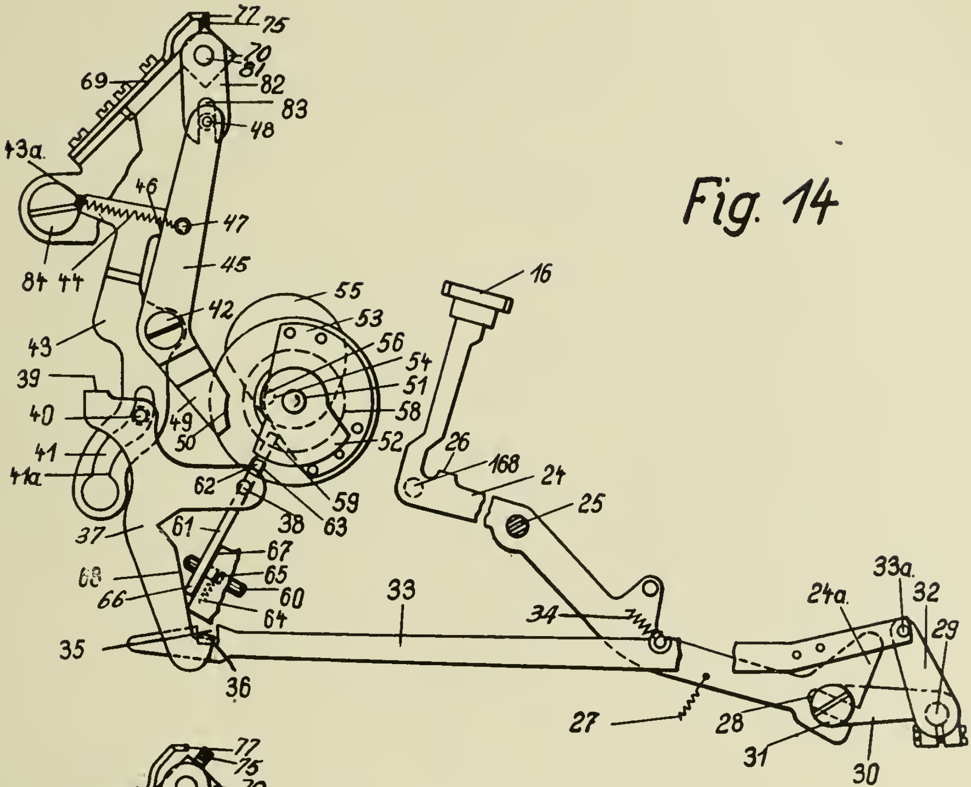

Fig. 14

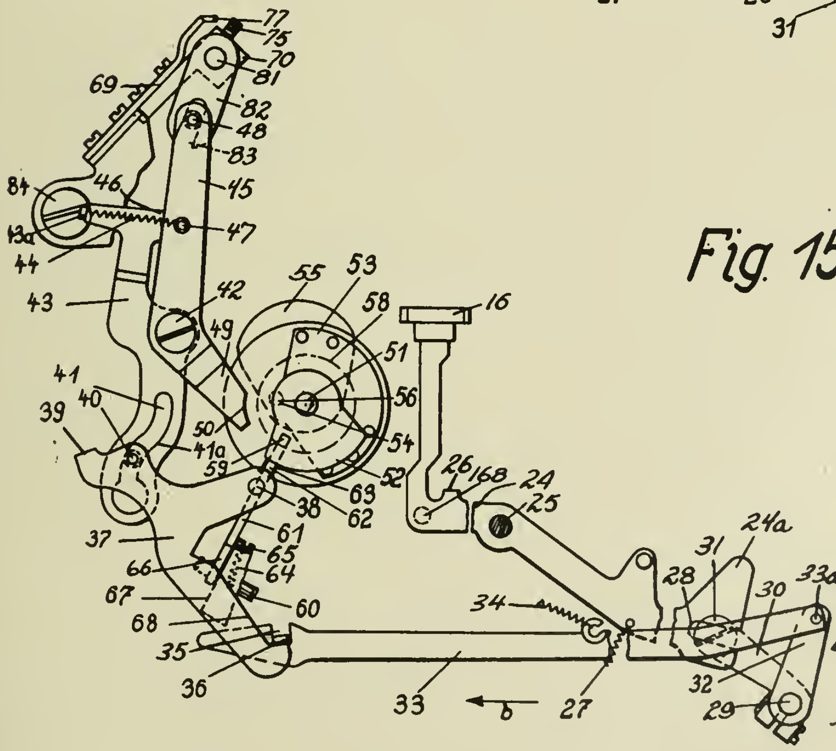

Fig. 15

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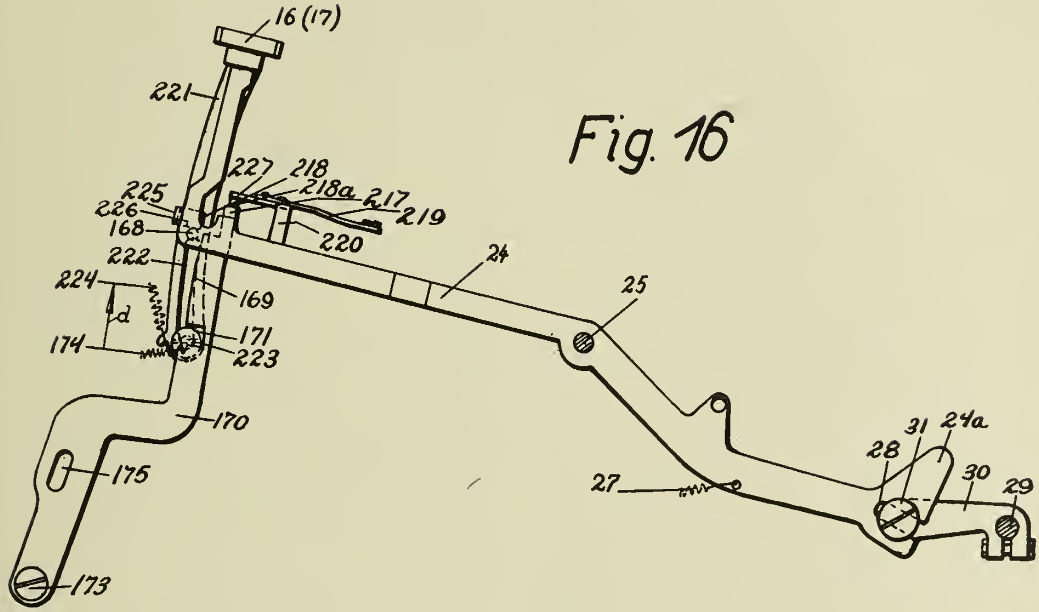

Fig. 16

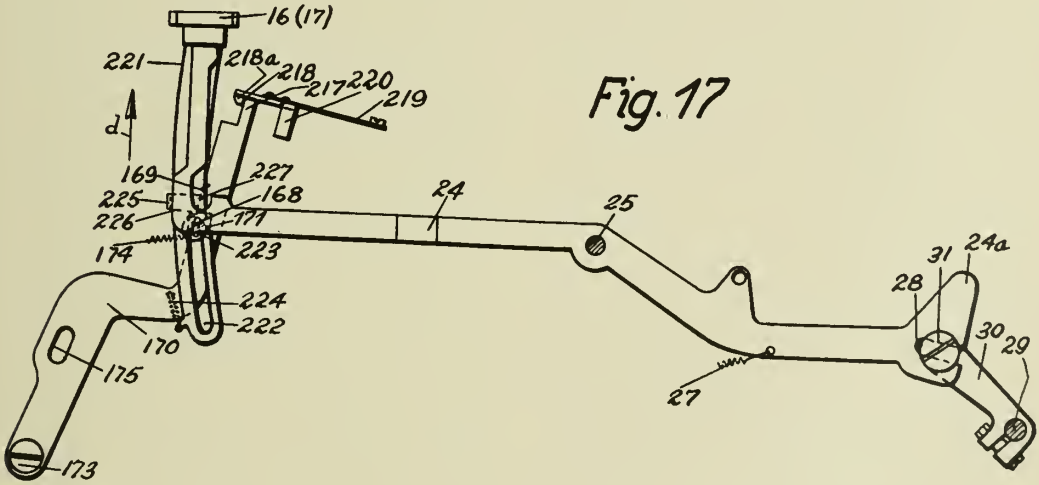

Fig. 17

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ALIEN PROPERTY CUSTODIAN

HELICOPTERS

Raoul Hafner, Vienna, Germany; vested in the Alien Property Custodian

Application filed August 6, 1938

This invention relates to helicopters, that is to say to aircraft having supporting rotors mechanically driven in normal flight and each comprising a plurality of blades radiating from a hub structure.

It is commonly assumed that the most desirable form of helicopter is that which will support the greatest weight for a given power input when hovering stationary.

This object will, however, involve a sacrifice of efficiency in forward flight, and the present invention is based on the contrasting view that one of the most important features of the helicopter as a type is the possibility of obtaining a high power efficiency in ordinary forward flight, and that it is essential to secure this even at the expense of an appreciable loss of hovering efficiency. Such a loss should not be a serious handicap in practise, since in any case it is nowadays possible to provide an ample power reserve.

It is therefore the basic object of this invention to obtain the maximum power efficiency of helicopters in forward flight, and for this purpose I contemplate providing helicopters with rotor systems so constructed as to absorb the flight power input at a relatively high tip speed and consequently at a relatively low torque. I find that although this means an appreciable increase in power for hovering flight, the torque is nevertheless substantially reduced as compared with slower rotors even during such hovering.

Consideration will show that, for a given forward speed of the aircraft, a high-speed blade will be subject to a smaller cyclic fluctuation of its effective angle of attack during rotation than a low-speed blade; as a result the angle of attack, at least at moderate speeds, may remain relatively close to the angle giving the best ratio of lift to drag for the blade section used, with a consequent gain in efficiency. Moreover the maximum forward speed of the aircraft is also increased by a high-speed rotor system, since the blades on the retreating side not not stall until a correspondingly high translational speed is reached.

These results are obtained quite generally in all types of helicopters, but a high-speed low-torque rotor is of especial advantage in the single rotor type of helicopter, as will be explained later.

I have obtained an expression for the torque dQ absorbed by an annular element (of radius r) in a rotor disk when giving an axial thrust or lift dT. This is found to be:—

$$dQ=dT.r.\left[\frac{C_{D_p}}{C_L}+\frac{1}{2}\sqrt{C_L.\sigma}\right]$$

where C_{Dp} and C_L are respectively the profile drag and lift coefficients (in Continental units) of the blade section used, and σ is the solidity (i. e. the ratio of blade area to disk area) over the annular area in question.

From this, it will be seen that the non-dimensional expression

$$\left[\frac{C_{D_p}}{C_L}+\frac{1}{2}\sqrt{C_L.\sigma}\right]$$

is a measure of the torque absorbed by a given rotor element at a given light, and it will therefore be referred to for simplicity as the "torque factor." Since C_{Dp} and C_L vary somewhat for a given blade section according to the angle of attack for which they are quoted, it will be convenient to refer to the minimum value of this torque factor.

The different annular areas will have different solidities in the general case, and consequently the minimum torque factor will vary along a blade; normally of course it will diminish towards the tip. Also, in view of these changes in solidity. the torque factors will be at a minimum for different values of C_{Dp} and C_L.

However, by examination of a rotor in conjunction with the lift/drag curve of the blade section used, the mean value of the minimum torque factors over the whole lifting portion may readily be determined, and this is a criterion of a helicopter rotor according to the invention.

Thus, although the proposal to construct helicopters on what may be termed the "high-speed rotor" principle is in any case new, as far as I am aware, the present invention may be stated for the purpose of definition as a helicopter in which the rotor system is constructed to absorb the flight power input at a high tip speed and a correspondingly low torque by providing a blade section and a rotor solidity such that the mean of the minimum torque factors over the whole working or lifting portion of a rotor disk has a value below 0.09.

Another convenient way of expressing the invention takes account of the ratio of the torque on a rotor to its thrust when hovering stationary. This may be ascertained by direct measurement, and its units will evidently be units of length. When expressed as a proportion of the rotor radius, it is a criterion of the rotor from the present point of view.

Again. this figure will vary somewhat according to conditions (more especially pitch setting) but the invention may be stated as a helicopter in which the rotor system is constructed to absorb the flight power input at a high tip speed and a correspondingly low torque such that the ratio of torque to thrust of a rotor in stationary hovering has a minimum value below 0.09 of the rotor radius.

It also appears that if a helicopter rotor is constructed to operate at a sufficiently high

speed, the influence of flow through the rotor on the effective angle of attack of the blades may be so reduced that the optimum pitch setting for power operation (at least in ordinary forward flight) lies within the auto-rotational range of pitch settings, and a useful alternative definition of the invention is therefore a helicopter with a rotor system having this feature. In such a helicopter, a failure of the drive (assuming of course that the customary freewheel is fitted) would not demand an instant adjustment of pitch to keep the rotor system in action, and the value of such an inherent feature will be apparent.

The invention is particularly important in its application to the single-rotor helicopter. This type is generally recognised as having greater possibilities than the double or multi-rotor types, because it avoids the mass and complexity of duplicated driving and control connections, and also in certain arrangements the weight and drag of outrigger structures for carrying rotors. The single rotor has a good lift distribution across the span in forward flight, and the complete aerodynamic control of the aircraft may be very simply arranged by providing means for tilting the plane of rotation of the rotor in any direction and for varying its pitch as a whole.

So far, however, the problem of neutralising the torque reaction on the fuselage during hovering (at any rate whilst still obtaining a useful forward flight) has prevented the practical development of a satisfactory single-rotor helicopter.

By providing such a machine with a single rotor according to the invention, however, the torque reaction is made so low that it can be counteracted even during hovering by means which do not substantially affect the general efficiency in forward flight. For example, by shaping the fuselage to conform with small effective "angles of attack" to the rotor downwash, a sufficient counter torque may be aerodynamically imposed on it during hovering without the aid of "external" devices impeding forward flight.

A single-rotor helicopter according to the invention and constructed on this principle is illustrated by way of example in the accompanying drawings, of which:

Figure 1 is a side elevation,

Figures 1A to 1F are cross-sections viewed from the front of the fuselage in the planes A—A to F—F respectively of Figure 1,

Figure 2 is a plan view,

Figure 3 is a front elevation,

Figure 4 shows the blade section on an enlarged scale, and

Figure 5 is an enlarged and somewhat diagrammatic sectional view of the power transmission means between the engine and the rotor.

Dealing first with the general construction of the rotor of the machine shown; the three blades **1** are attached to the hub **2** by articulations allowing them to flap up and down and to execute independent "drag" movements to some extent in the plane of rotation. The rotor is general in constructed and controlled as described in United States Patent Application Serial No. 115,530 filed 12th. December 1936, the blade pitch angles being "differentially" controlled to tilt the plane of rotation by a universally-tiltable control column **3** (Figure 1), and the general or mean rotor pitch being adjustable as a whole by the "lift" lever **4**.

The working or lifting portion of each blade is about the outer two thirds thereof, the inner third being a simple streamlined supporting spar which encloses a radial tie rod anchoring the blade to the hub. The torsional resilience of the tie-rod is arranged to stabilise the blade at its optimum mean pitch for forward flight, and it also takes the centrifugal load of the blade, allowing its pitch to be altered without friction or wear. This feature is fully set forth in the said Application Serial No. 115,530, and it is therefore unnecessary to illustrate it in detail here.

The airfoil section chosen for the lifting portions of the blades is the high-speed section shown in Figure 4 and known as N. A. C. A. 23009. The maximum thickness is 9% of the chord, and the blade is built with a stressed skin **5** of stainless or plated steel sheet. The blade is suitably weighted and stiffened at the nose and, in general, constructed in accordance with the principles set out in United States Patent Application Serial No. 169,382 filed 16th. October 1937. That is to say, each sectional element of the lifting portion has a substantially constant center of pressure situated at the mass center of the element, and the blade is so shaped that all these centers lie on a common straight line or axis of balance X, the neutral torsional axis or "stiffness" axis of the blade being arranged at or in front of the axis X. In the present case these axes are arranged to coincide with each other and also with the tie-rod axis about which the blade is turned to adjust its pitch. As explained in the said Application Serial No. 169,382, this arrangement gives a dynamically balanced blade free from fluttering tendencies in flight, and this is evidently important in view of the long, thin and narrow nature of the blades in the present case.

The blades are tapered in plan so as to give the optimum lift distribution over the lifting area of the rotor disk, and are given a suitable twist along their length to keep the effective angle of attack correct at each point during flight. The overall rotor solidity is under 4%; at the points M it is of course greater, and over the annular element of area containing these points the solidity is 6.30%. From the published data relating to the section N. A. C. A. 23009 it is found that the minimum value of the torque factor

$$\left[\frac{C_{D_p}}{C_L}+\frac{1}{2}\sqrt{C_L \cdot \sigma}\right]$$

is 0.087 when $\sigma=0.063$, and is obtained by using the values $C_{Dp}=0.0067$ and $C_L=0.19$.

Similarly, at points N the solidity has the much lower figure of 1.10%, and the torque factor is found to be at a minimum of 0.05 when the values $C_{Dp}=0.0071$ and $C_L=0.36$ are used.

In the first case the values of C_{Dp} and C_L used are those quoted for an angle of attack of 1° and in the second case they relate to an angle of 2.5°; it will be appreciated however that these angles are mentioned only because they happen to give the minima in calculating the torque factors, and that they have no significance as regards the actual setting of the blades.

Thus we have minimum torque factors of 0.087 at M and 0.05 at N, and it is obvious that if (for example) further values are taken at equidistant points along the rotor radius the mean value over the whole lifting portion will be found to be well below the limit of 0.09.

Investigation shows that, as previously men-

tioned, the optimum pitch setting of this high-speed rotor for ordinary forward flight is also one at which the rotor will auto-rotate in the event of engine failure. This is evidently a most valuable feature, even if it is advisable subsequently to reduce the pitch to obtain the actual optimum auto-rotative condition.

As shown in Figures 1 to 3, the fuselage 7 is generally fish-shaped, being relatively deep and narrow. At its central part it has a roughly oval symmetrical cross-section (see Figure 1C), but its shape is progressively modified towards the nose and tail into unsymmetrical airfoil sections (see Figures 1A, 1B, 1D and 1E), which are upwardly directed but oppositely cambered.

Thus the fuselage has, in effect, the form of an airscrew of very high pitch freely carried on the rotor axis, and tending to revolve in the down-wash of the rotor. From the drawings it will be seen that the rotor revolves clockwise in plan, and that the fuselage tends also to revolve in this sense, i. e. in opposition to the mechanical torque reaction on it. Investigation shows that in the aircraft illustrated a complete neutralisation of the torque reaction in this way can be expected even while hovering, whilst it is evident that the fuselage is at the same time wholly suited for fast forward flight.

The curve of the fuselage top (Figure 1) is arranged to follow closely the droop of the blades when at rest, in order that the fuselage may have the maximum area as an airfoil and also so that its ends (which are most effective in providing the aerodynamic counter-torque) shall not be unduly far below the rotor disk in flight.

These objects may if desired be more fully met by giving the blades during manufacture a slight inherent upward curvature or "set" to reduce their droop when at rest. During flight, centrifugal force would of course entirely overcome any such "set."

Since the fuselage is approximately symmetrical in side elevation about the rotor axis and center of gravity C. G. (Figure 1), it is provided at the rear with an adjustable tail fin or rudder 8 of large area for directional stability and control, and also has a tailplane 9 (which may be adjustable) to assist in maintaining trim. These surfaces are mounted well clear of the rotor downwash in all conditions of flight.

It will be appreciated that, for a given throttle opening, the degree of torque counter-action required from the fuselage proper may vary somewhat according (for example) to whether the machine is flying level or climbing. It may prove possible so to shape the fuselage that these variations will automatically be met in view of the differences in distribution of the downwash over the fuselage, and in any case they can be offset by tilting the rotor slightly to one side and turning the rudder to the same side, thus producing an auxiliary corrective couple on the machine. Also, if desired, flaps or "ailerons" 10 may be fitted for modifying the effective camber of the fuselage and connected to an operating lever 11 in the pilot's cockpit, or to the rudder bar (not shown).

In ordinary forward flight, however, the action of the fuselage alone will be quite sufficient, and in this connection it may be mentioned that with a suitable rotor the helical component of the downwash may in itself give all the necessary angle of attack on the fuselage. In such a case the fuselage could be absolutely symmetrical about the longitudinal vertical plane, the auxiliary couples being applied when necessary by either of the above methods.

As regards the rotor driving mechanism; this comprises an engine and clutch unit 12 (Figure 1) below the rotor, which it drives through a jointed and telescopic vertical shaft 13 coupled at its upper end to the rotor hub. The engine also drives a fan or blower (not shown) for drawing cooling air through an aperture 12*a* in the fuselage and expelling it through a similar aperture on the other side.

As shown somewhat diagrammatically in Figure 6, the engine crankshaft 14 is geared by bevel pinions 15 and 16 to a vertical clutch driving shaft 17 on which the driving clutch plate 18 is splined. A spring 19 normally holds this plate up to the limit of its travel. The driven plate 20 rests on the plate 18, and is similarly splined to the driven shaft 21. This shaft 21 is connected through a freewheel device 22 and a universal joint 23 to the lower end of the telescopic driving shaft 13, and the upper end of the latter is similarly jointed at 24 to the shaft of the small pinion 25 meshing with the rotor hub pinion 26.

The arrangement is such that the drive will fracture at or near the part 25, 26 as a safety measure if for some reason it becomes jammed lower down. This may be ensured, for example, by pinning the final pinion 26 to its shaft by means of a key (not shown) adapted to shear on the application of a shock torque exceeding a predetermined maximum figure.

In view of the nature of the blades it is important that when accelerating the rotor from rest, and in fact until it has attained sufficient speed for centrifugal force to take effect, the maximum torque imposed on it shall be strictly limited in order to avoid bending and damaging the blades or their root fittings.

For this reason the operating mechanism of the clutch 18, 20 is arranged in accordance with United States Patent Application, Serial No. 33,462, filed 27th. July 1935, namely so that the maximum torque transmissible by the clutch (i. e. its effective degree of engagement) is automatically reduced at low speeds of the driven plate 20 and therefore of the rotor. For this purpose the driven clutch shaft 21 carries pivoted centrifugally-actuated cams 27 adapted to exert an increasing engagement pressure on the plates as the rotor speeds up. Initially the cams 27 are in the position shown, and their weight exerts on the plate 20 a relatively light engagement pressure, such that only sufficient torque may be transmitted to get the rotor started without straining it. As the rotor speed increases the cams 27 press the driven plate 20 harder against the driving plate until, when the rotor has attained sufficient speed, the clutch is capable of transmitting the maximum torque of the engine. Provision is made for manually disconnecting the clutch at any time by means of a pivoted forked lever 28 which is operated by a cable 29 from the pilot's cockpit to withdraw the clutch plate 18 against the pressure of the spring 19.

The rotor will normally be put at the no-lift pitch setting while being started up. Its rotational drag is then abnormally low, and it can therefore be raised to an abnormally high speed before the lift lever 4 is operated to effect the direct take-off. The initial acceleration away from the ground will therefore be high, but since the engine will be running at a high speed while lightly loaded it will not be delivering an unduly high torque, the excess lift being obtained rather

from the excess kinetic energy of the rotor. In any case, the fuselage has a high polar moment of inertia and a general resistance to rotation during this relatively brief period, especially in view of its large tail.

The machine is mounted on an undercarriage of what is known as the tricycle type, comprising two main supporting wheels **30** situated slightly behind the center of gravity C. G. and a single forward wheel **31** which may be freely castoring or, preferably, steerable by being connected to the pilot's rudder bar.

The fuselage may readily be constructed as a watertight hull so that the helicopter is amphibian. In this case the leg structures **32** carrying the main wheels **30** may be pivoted at their roots about longitudinal axes at **33** (see Figure 3) so that the wheels **30** may be placed at the surface of the water when the aircraft is afloat and act as lateral stabilising floats; if desired, additional buoyancy members **34** may be incorporated in the structures **32** as shown. It may be noted that in this position the rebound-damping means usually associated with undercarriage legs will act to damp out rolling movements of the floating aircraft.

Further upward movement of the undercarriage members about the axes **33** in flight may be arranged to bring them into a fully retracted position nesting in the fuselage sides below the rotor hub.

A contemplated form of helicopter constructed as above described and as shown in the accompanying drawings has a rotor radius of about 19.6 feet and an all-up weight of about 2400 pounds. Investigation shows the minimum torque for hovering to be about 2400 lbs. ft. Thus the ratio of minimum hovering torque to weight is unity (one foot); that is to say 0.051 of the rotor radius.

RAOUL HAFNER.

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R, HAFNER

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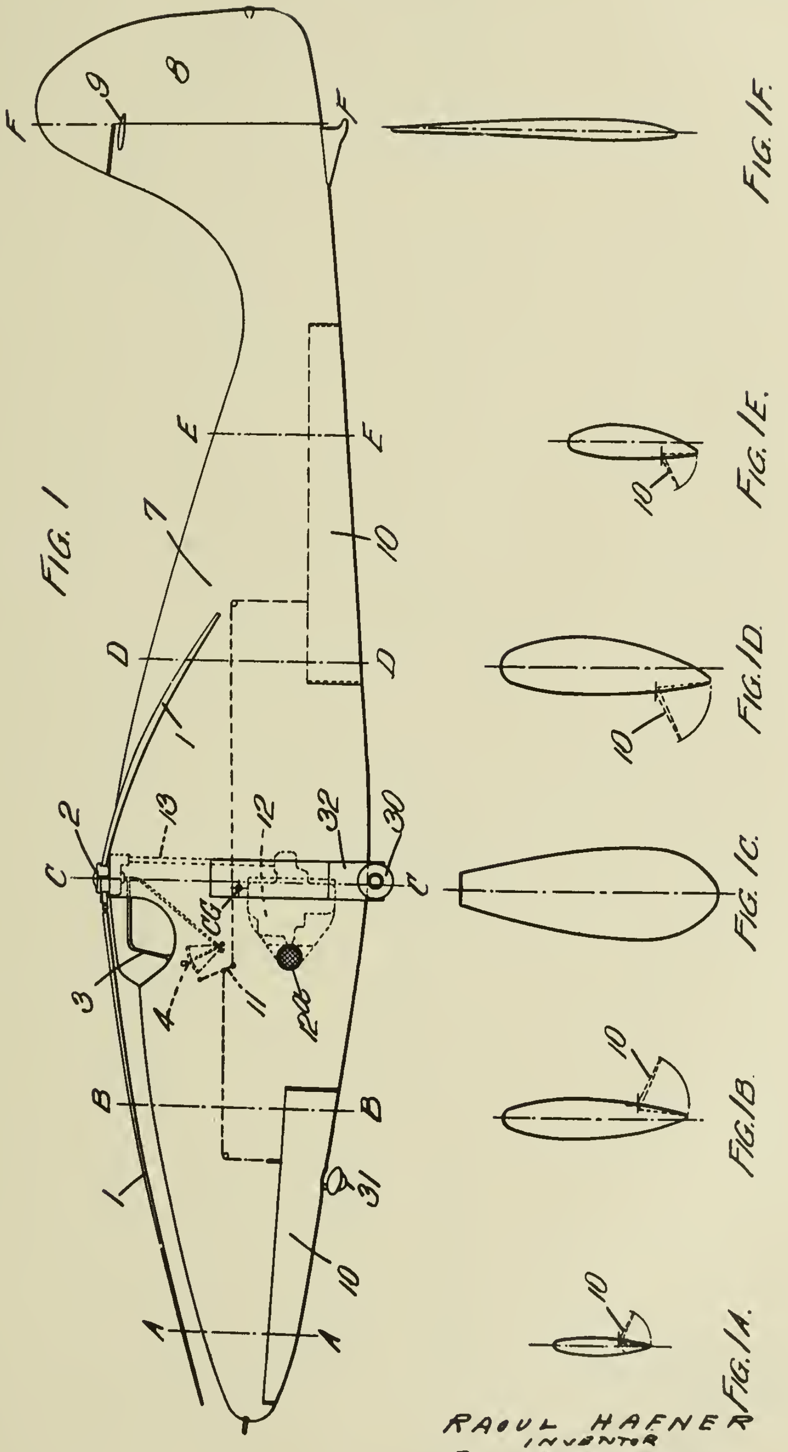

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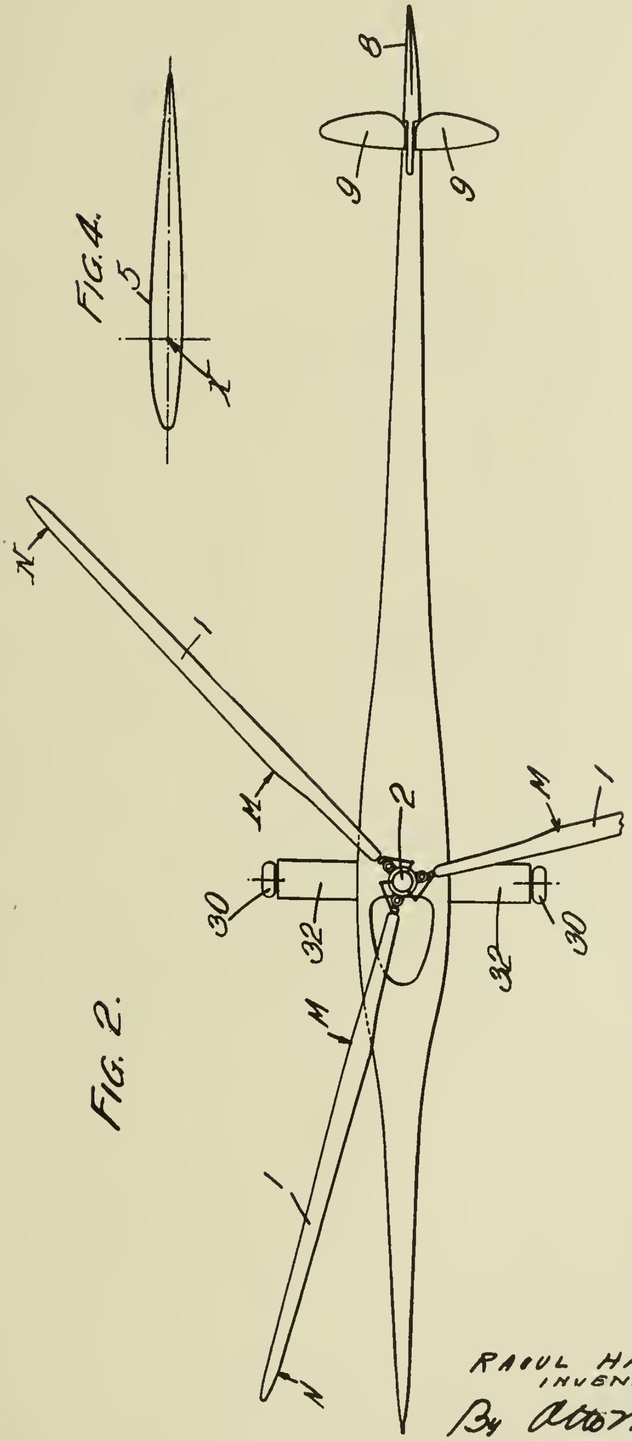

FIG. 4.

FIG. 2.

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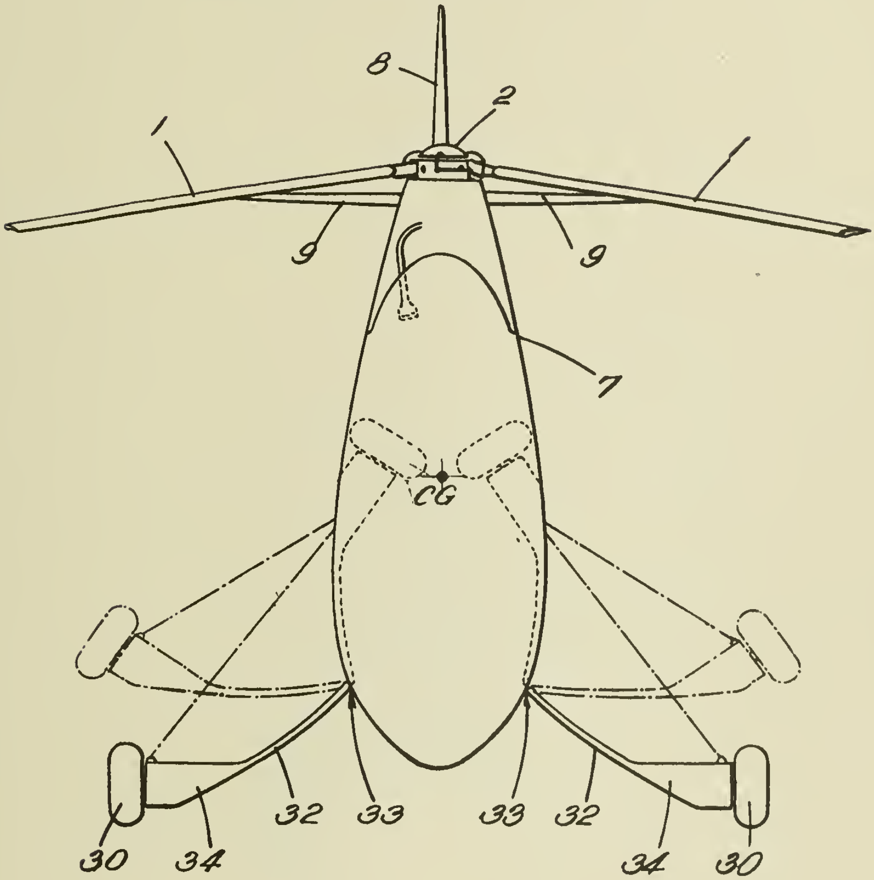
FIG. 3.



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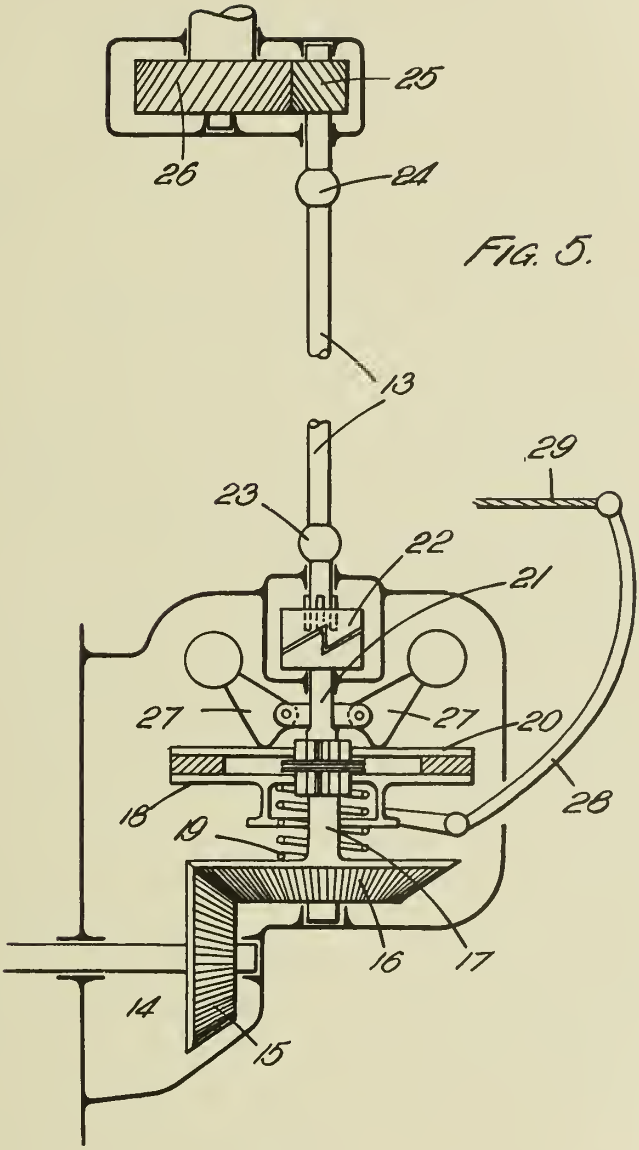

FIG. 5.

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ALIEN PROPERTY CUSTODIAN

COVERING FOR AIR-PLANES

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No Drawing. Application filed August 17, 1938

This invention relates to a process of covering air-planes and air-plane parts.

The air-plane canvas which has hitherto been used in the aircraft industry is made of linen because of its comparatively high resistance to tearing. A disadvantage of it is its sensitivity to water, which has to be remedied by careful and tedious lacquering and care has to be taken to produce a smooth aero-dynamically favorable surface by a special tensioning process involving in some cases repeated lacquering.

It is therefore an object of the present invention to provide an improved and simple process for producing air-plane coverings insensitive to water.

A further object resides in the provision of air-plane parts which possess a tightly fitting and water-proof covering.

Still further objects will appear from the following detailed specification.

We have found that the aforementioned objects may be achieved by making the covering from a fabric which consists of polyvinyl chloride produced as described in U. S. Patent No. 1,982,765. The mechanical and chemical properties of such polyvinyl chloride have been described in said specification, especially its fastness to water. A fabric made from this polyvinyl chloride has a resistance to tearing which is sufficiently high for the usual requirements. A further advantage which is of special importance for the purpose in question is that this material may be strongly tensioned by a simple short treatment at 135° C., for example for 2 minutes. The material may alternatively be tensioned by cautious treatment with a suitable volatile solvent or mixture of solvents. Furthermore, by a single or multiple lacquering with a lacquer of the same material a completely smooth surface is obtained which, even if, before being coated, the fabric is loose, ensures that it will be under high tension after drying. The several treatments just named may be combined by application either simultaneously or in succession.

For strengthening a fabric of polyvinyl chloride it may be laminated with a sheet of the same or similar material of any desired thickness, and so also another kind of fabric may be stuck to it in any suitable manner so as to reinforce it in desired degree in respect of mechanical or other properties, for instance waterproof character, incombustibility, high resistance to rupture and the like. To increase the stability to light, particularly to ultra-violet radiation and to heat rays, a polyvinyl chloride fabric or the covering lacquer may be incorporated with a material which by suitable absorption of the rays in question lends the required protection.

The application of the fabric to the supporting structure of the air-plane body may be carried out in the usual manner.

GUSTAV WILMANNS.
PAUL MÖLLER.

them. The bridges or webs 9 are shown in Figure 1 in dotted lines. The air set in motion by means of the blower or fan 3 follows a path indicated by arrows P.

In Figure 2 a traction screw 20 is suitably mounted at the front end of the fuselage the said screw 20 being driven by a motor 21. At the tail end of the fuselage a tail unit is mounted in the usual manner. A blower or fan 22, which is driven by a motor 23, is arranged at the place where the fuselage has the largest diameter. The difference in comparison with the arrangement according to that shown in Figure 1 lies in the fact that the fan or blower housing 24 forms at the same time a part of the envelope, or fuselage covering. The fan or blower housing 24 thus forms the middle part of the fuselage, which extends from the separating plane A to the separating plane B. A fore end unit 25 of the fuselage and a fuselage rear unit 26 are joined to the middle fuselage unit at those planes.

The fore part 25 of the fuselage is provided with air inlet openings as indicated at 27 and in a similar manner the fuselage rear part is provided at 28 with air outlet openings. The fore part 25 and the rear part 26 of the fuselage are provided with bulkheads 29 and 30 and with longitudinal stiffening members 31, which protrude beyond the end planes of the fuselage fore and rear parts and which serve as a means of connecting them to the fuselage middle part 24.

The path followed by the air current is indicated in Figure 2 by the arrows P.

Figure 3 drawn to an enlarged scale shows the end plates of the fore part 25 of the fuselage as seen in the direction of the arrow P_1. The air inlet openings 27 are clearly shown and the walls thereof which form the intervening webs or bridges are so shaped, as to act as guides for the air. Channel sections 31 are arranged between the air openings as clearly shown in Figure 3.

Figure 4 shows a longitudinal section through an air inlet or outlet opening. It will be observed from Figure 4 that the wall of the air guide is hollow at 32, so that the cooling water can circulate through it.

CLAUDE DORNIER.

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PROPELLING PLANT FOR AIRCRAFT

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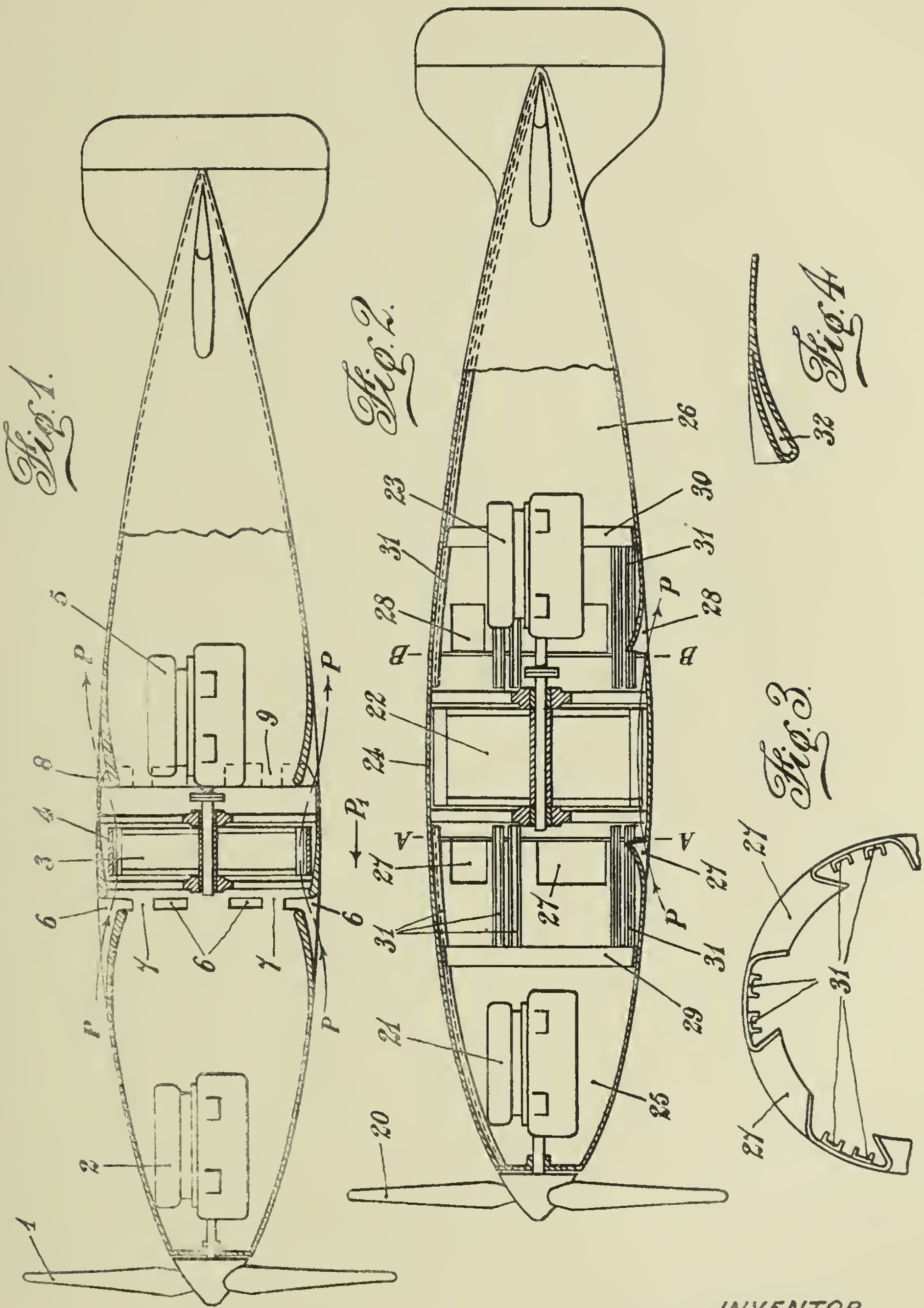

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ATTORNEY

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Serial No. 227,220

ALIEN PROPERTY CUSTODIAN

ACCOUNTING MACHINES

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Application filed August 27, 1938

The present invention relates to an accounting machine comprising a movable paper carriage, a balancing mechanism from which positive and negative sums can be automatically posted, a series of computing devices into a predetermined number of which are entered the sums calculated by the balancing mechanism, and a device to automatically select the computing mechanism in dependence of the respective columnar position of the paper carriage.

Accounting machines of this type are known in which computation the balancing mechanism is accomplished by manual operation in accordance with the prefix of the respective contents of the balancing mechanism, and wherein different computing devices are selected in each case to enter the sums formed by the balancing mechanism. Machines of this type necessitate particular attention of the operator and are not safe from errors which may occur due to faulty manipulation, and their operation involves intricate manual operating mechanism.

The present invention consists in that a control device is provided which is automatically controlled in accordance with the prefix of the contents of the balancing mechanism, which, on computing from the balancing mechanism while the paper carriage is in a predetermined position, controls the device to automatically select the computing mechanism in such a way that in case of a negative sum, a different computing mechanism will be selected as in case of a positive sum.

The accompanying drawings illustrate a preferred embodiment of the invention, and in which:

Fig. 1 is a sectional view of an accounting machine, according to the invention;

Fig. 2 is a lateral view of the control device and the selecting device of the computing mechanism;

Fig. 3 is a side view of the selecting device for the computing mechanism in accordance with Fig. 2, having its parts in a different position;

Fig. 4 is a lateral view of the control device for the balancing mechanism;

Fig. 5 is a side view of the control device for the balancing mechanism in accordance with Fig. 4 with its parts occupying a different position;

Fig. 6 is a sectional view of the selecting device for the computing mechanism, taken on line 6—6 of Fig. 2;

Fig. 7 is a detail view of the selecting device of the computing mechanism according to Fig. 6, with the parts in a different position;

Fig. 8 is a side view of an indicating device for the prefix of the contents of the balancing mechanism;

Fig. 9 is a top view of the device shown in Fig. 8;

Fig. 10 is a top view of a control device partly in section and taken on line 10—10 of Fig. 2; and

Fig. 11 is a view similar to Fig. 10, showing the parts in a different position.

The embodiment of the accounting machine, illustrated by way of example in the drawings is essentially similar to the machine disclosed in U. S. Applications Serial Nos. 39,065 and 181,440, filed September 3, 1935 and December 23, 1937 respectively and therefore only the parts of the machine are herein described and illustrated which are necessary for a full disclosure of the present invention.

The accounting machine according to the invention is provided with a main shaft 1 (Fig. 1) carrying a cam 8 rigidly connected thereto. Toothed segments 3 are mounted for free rotating movement on a shaft 2, which latter furthermore carries, likewise mounted thereon for rotating movement, a forked lever 10, the left arm of which carries a roller 9.

A spring 11, acting upon the forked or cranked lever 10, urges the roller 9 against saddle or cam 8. The right arm of the forked lever is provided with a saddle or seat portion 12. The toothed segments 3 are held against the seat 12, by means of springs 14 and lugs 13.

To begin the operation, the main shaft 1 describes a swinging movement in clockwise direction, whereby the lug 8 release the roller 9 so that the cranked lever 10 may swing in counter-clockwise direction due to the action of the spring 14. The tooth segments 3 are hereby released from the seat 12 and, due to the effort of the springs 14, swing about shaft 2 in counter-clockwise direction. Pivotally connected at 15 to the tooth segments 3 are regulating slides 7, which are shifted towards the left, (Fig. 1) on upward movement of the tooth segment 3. The regulating slides 7 are provided with lugs 6 adapted to co-operate with key shafts or rods 5 of the summing up or totaliz-keys 4. In accordance with the lowered summing up key the regulating slides 7 come, sooner or later, to a stop during their movement to the left, due to the engagement of one of the stops 6 on the corresponding lowered key shaft.

The toothed segment 3 which is connected to the corresponding regulating slide 7 is hereby set

upon the numeral corresponding to the lowered summing-up key 4.

In the embodiment shown a balancing mechanism 16 is provided having an upper and a lower set of wheels, and which is adapted to directly engage the toothed segments 3. Furthermore a series of computing mechanisms are provided, two of which, 17, 18 are shown. The computing mechanisms 17 and 18 are driven by means of a particular tooth formation 20 on the toothed segment 3, in cooperation with double-toothed racks 19.

A writing roller or platen 21 is supported in the lateral walls 22, 23 of a paper carriage 24. Fastened on the paper carriage 24 are two slide rails 25, 26 (Fig. 2), by means of which the carriage is guided on rollers 29 on two slide bars 27, 28 fastened on the machine frame.

Types 30 of the type carriers 31 can be impressed upon the writing roller 21. The type carriers 31 are pivoted on the toothed segments 3, and, on regulation of these, are set on the struck number. Pressure hammers 32 are provided for producing an imprint by projecting the type carriers 31 against the writing roller.

In the bottom plate 33 (Fig. 2) of the paper carriage is formed an opening 34, into which a frame may be inserted. This frame comprises a front rail 35, a rear rail 36, and two lateral connection webs which are not shown. The frame 35, 36 rests, together with the lateral connecting webs, upon the bottom plate 33 of the paper carriage 24.

Both the front rail 35 and the rear rail 36 are provided with inter-corresponding slots 209, 210. These slots are adapted to receive the control lug holders 37. These holders carry in any desired number of slots or recesses 38 and any desired number of control elements 39, which have for their object the setting of the accounting machine for the various operations at any columnar position of the paper carriage. They may all be uniformly shaped or may be more particularly adapted to each individual operating method.

According to their position, on the control element holder 37, the functions of control elements 39 will vary, as is well known. Thus, e. g., the control elements 39 are capable of determining any desired operation of the counting devices, such as subtraction, non-addition, sum and, or, intermediate sum.

Furthermore certain counting devices may also be selected by the control elements 39. To this effect several forked levers 41 are mounted on a shaft 40, to co-operate with the control elements 39 in such a manner that they may be swung out by these. The forked levers 41 are connected to pulling wires 42 to which an upward movement is imparted by the control elements 39 on swinging out of the cranked levers. The lower ends of the pulling wires 42 are connected to discs 43 which are adapted to swing about a common axis 44. A connecting rod 47 is fastened to each of the discs 43 by means of a pin and slot connection 45, 46, the connecting rods 47 being drawn towards the right, (Fig. 2), by means of a spring 48, disposed between connecting rod 47 and disc 43. The left ends of the connecting rods 47 are fastened by means of journals 211 to the discs 49. The discs 49 are arranged for swinging movement upon a common shaft 50, and carry pins 51, 52 which latter may selectively co-operate with rods 53, (Figs. 2, 3).

On imparting a swinging out motion to a lever 41 by means of a control element 39 and thereby cause the corresponding pull wire 42 to describe an upward movement, the corresponding disc 43 will be rotated in counter-clockwise direction. The disc 49 is hereby caused to rotate in clockwise direction by the rail 47, whereby the pin and slot connection 45, 46 is held in the position shown in Fig. 2 by means of the spring 48. Due to the rotation of the disc 49 stop pin 52 causes one of the rods 53 to move downwardly against the effort of a spring 212 (Fig. 3). The rods 53 are provided on their lower part with a slot 54, by which they are enabled to contact on downward movement with a pin 55 of a saddle or seat 56.

The saddle 56 comprising two arms is mounted for turning movement about a journal 57 and is adapted, while rotating, to shift the rods 53 back and forth which, in each case, are in contact with the pin 55.

The rods 53 may be linked to levers 58, 59, 60 or also by means of a forked lever 61 and a link 62, to a lever 63. The levers 58, 59, 60, 63 are mounted on shafts 64, 65, 66, 67 carrying revolving plates, two of which, 68, 69 are shown in Fig. 1. On swinging the revolving plates 68, 69 in counter-clockwise direction, the shafts 73, 74 of the counting mechanism, which are carried by levers 77, 78, oscillating about shafts 75, 76, are moved upwardly against the action of the springs 70, 71. As a result of such upward movement the counting gears of the computing mechanism 17, 18, mounted on the shafts 73, 74 of the counting mechanism will mesh with the racks 19 which, on each movement of the toothed sectors 3, are moved back and forth by means of the toothed formation or sector 20 in the pin slot guides 79, 80 and 81, 82 respectively.

As stated herebefore, the counting mechanism is connected or disconnected by means of the saddle 56 and the pin 55. The saddle 56 is connected to an arm of a forked lever 85 by means of a rod 84, which is fastened to a swing bolt 83 (Fig. 2). The forked lever 85 is mounted for rotating movement about journal 86. With its upper fork-shaped arm, the two-armed lever 85 grips a pin 87 of an anchor 88. The latter is guided in slots 91 and 92 on the machine frame by means of a pin 89 and a slide block 90. The larger front end of the lever is provided with several pawls 93, 94, 95 and a contacting surface 96, allowing its selective co-operation with pins 97, 98 of a control disc 99 fastened to the main shaft 1. The pawls 93, 94, 95, according to the embodiment shown, can be selectively engaged by or disengaged from pins 97, 98, by means of springs 100, 101, 102. The connecting and disconnecting movement of these pawls can be effected either by hand or automatically as will be more fully described hereinafter.

As the pawl 94 is connected at the anchor 88 (Fig. 2), the pin 98, during its turning movement in the direction of the arrow 103 at the end of the advancing movement of the machine, travels past pawl 94, swinging same only slightly out against the effort of spring 101.

According to the particular stage or period of time of the operation at which the computing mechanism 17, 18 is engaged with, or disengaged from the racks 19, varied counting operations will be carried out by the computing mechanism 17, 18. The further computing mechanism, and which are not illustrated, correspond to computing mechanism 17, 18 and are adapted to be coupled with the toothed racks 19 by rotating shafts 66, 67 (Fig. 2).

As the machine starts its rearward movement during which the control disc 99 moves back to its original position in clockwise direction, the pin 98 contacts the head 104 of pawl 94 and thereby moves anchor 88 in its slots 92, 91 towards the right in Fig. 2. This movement towards the right of the anchor 88 determines the movement over the parts 85, 84, 56, 55, 53 towards engagement of the already selected computing mechanism. The anchor 88 remains in this position and the corresponding counting device remains connected until, at the end of the rearward movement of the main driving shaft 1, the pin 97 strikes the stop surface 96 and thereby returns the anchor 88 toward the left in Fig. 2, into its inoperative position. The corresponding computing mechanism is thereby simultaneously disconnected.

Each computing mechanism 17, 18, similarly as the computing mechanism not shown, is provided with its proper connecting device for tens, which may be of any appropriate design.

For adding and subtracting computing mechanism any known type of connecting device for tens may thus be used. Since a separate connecting device for tens is provided for each computing mechanism, it is to be seen that several computing mechanisms, according to the embodiment shown, may be simultaneously engaged by the toothed racks 19.

In posting a sum, the pawls 93, 95 are swung either by hand or automatically, while the pawl 94, however, is disengaged from the pin 98. This is attained in the manner described hereinafter.

On pushing down the summing-up or totalizer key 105 for the computing mechanism, the key shaft or rod 106 abuts a lever 108 pivoting about the journal 107 and carrying two pins 109, 110. The pin 110 of the lever 108 is engaged by a lever 112 pivoting in 111. The lever 112 rests upon a pin 113 of the pawl 94, while the pin 109 of the lever 108 rests upon the pawl 93. To the rear of the lever 108 is provided a two-armed lever 115 which is mounted for oscillating movement about a journal 114, and which, likewise, is situated within reach of the shaft 106 of the summing-up key 105. A link 117 is fastened to a swing bolt 116 at the lower branch of the two armed lever 115, and carrying a pin 118 which is adapted to cooperate with the pawl 95 in such manner that the pawl 95 is normally held, against the traction effort of its spring 102, outside of the reach of the control pin 97. The link 117 is constantly drawn towards the right in Fig. 2 by means of a spring 119 the tension force of which is greater than that of the spring 102. The right end of the link 117 is pivotally connected to a lever 121 by means of a journal 120. The lever 121, together with the journal 122 is mounted for rotating movement on the machine frame.

On pushing down the summing-up key 105, the levers 108, 115 are swung out in clockwise direction by the key shaft 106. The link 117 is thereby moved over lever 115 towards the left in Fig. 2, whereby the pin 118 releases the pawl 94 which, due to the effort of spring 102, comes within the operating field of the control pin 97. Simultaneously the pawl 93 is brought within reach of the control pin 98, by means of the pin 109, while the pawl 94 is swung out in clockwise direction by the pin 110 of the lever 108 in co-operation with the lever 112. The control pin 97 of the control disc 99, while moving in the direction of the arrow 103, at the start of the operation, contacts a lug 123 of the pawl 95 and thereby shifts the anchor 88 towards the right, bringing the previously selected computing mechanism in engagement with the toothed racks 19 by means of one of the revolving discs 68, 69. The anchor 88 remains in its position towards the right until the end of the advancing movement when it is again moved toward the left by the pin 98 striking the pawl 93. Hereby the corresponding computing mechanism is likewise disengaged anew from the toothed racks 19.

To post an intermediate sum, the intermediate sum key 124 for the computing mechanism is pushed down. The key shaft or rod 125 of the intermediate sum key 124 is formed in such a manner that it will only influence the two-armed lever 115, but not the lever 108. On pushing down the intermediate sum key 124, as described herebefore, the pawl 95 is swung but not the pawl 93. As opposed to the summing-up or totalizing operation the pawl 94, on entering the intermediate sum, remains in operative position as shown in Fig. 2. At the start of the advancing movement of the machine, the anchor 88 is moved towards the right in Fig. 2 by the pin 97 in co-operation with the pawl 95 and the corresponding, previously selected computing mechanism, is thereby connected. At the end of the advancing movement of the machine drive the control anchor 88 will not be moved to the left, because the pawl 93 is not swung in. The position of the pawl 94 remains without effect upon the control of the anchor 88, since, due to the position towards the right of the anchor, the pawl 94 is positioned outside of the operating field of the pin 98. At the summing-up of an intermediate sum, the rearward movement of the anchor 88 occurs only at the end of the rearward movement of the machine drive while pin 97 contacts the stop surface 96 of the anchor 88. During the forward movement as well as during the rearward movement of the machine drive the previously selected computing mechanism is thus in engagement with the toothed racks 19.

Non-addition operations are carried out by holding the pawls 94, 95 in their swung out position during the forward movement as well as during the rearward movement of the machine drive. This is attained by pushing down the non-addition key 126 of the computing mechanism. The key shaft or rod 127 of the non-addition key 126 acts upon the lever 112 and thereby swings the pawls 94 in clockwise direction over the pin 113 against the action of the spring 101. Even as the pawl 93 is likewise swung by means of the pin 110 of the lever 108 and the pin 109, on swinging motion of the lever 112, pawl 93 will coact with the pin 98 since the anchor 88 has not left its inoperative position as pawl 95 is disengaged. It is obvious that setting of the machine to non-addition position may also be effected automatically and in a similar manner by the paper carriage, as will be described hereinafter in connection with the control of the balancing mechanism, as shown in Fig. 4.

In the present embodiment of the invention connection and disconnection of the computing mechanism 17, 18 can be automatically effected in accordance with the pre-setting of the control elements 39 in relation to the position of the columns of the paper carriage 24. However, in the

present example it is possible to select other computing mechanism than those which are precisely automatically selected in a certain position of the columns of the paper carriage during any desired function of the machine and in any columnar position of the paper carriage 24. To this effect a connecting mechanism is provided which, while one computing mechanism is connected by means of a corresponding key, automatically renders ineffective any connecting operation effected by the paper carriage with a view of determining the connection of the computing mechanism.

In the present embodiment selecting keys 128, 129, 130, 131 are provided co-operating with angular levers 132, 133, 134, 135 for the four computing mechanisms which are engaged by the toothed racks 19 on shafts 64, 65, 66, 67.

The angular levers 132, 133, 134, 135 are mounted on a common axis 213. Slides 136 are pivotally connected to the lower arms of the angular levers 132, 133, 134, 135 each of which is provided with an upper boss 137 and a lower boss 138. The upper boss 137 rests against a rod 139 of a saddle 140 which is mounted for rotating movement about the shaft 141.

When the key 131 is, e. g., pushed down, the saddle 140 describes a swinging movement in clockwise direction over the cranked lever 135 and the slide 136. The rod 139, due to contacting of the disc 49 at the left borders of recesses 142 formed therein, sets back all of those discs 49 to which a clock-wise movement had been imparted by the paper carriage in co-operation with a control element 39 on displacement of the pulling wires 42 and the rail 47. The rails 47, sliding on pins 45, in the slots 46 against the effect of springs 48 are hereby again moved toward the left in Fig. 2.

The discs 43 and the pulling wires 42 may thereby remain in their respective positions, in which they were placed at the corresponding columnar position of the paper carriage on setting of the control elements 39. Thus all control elements actuated by the paper carriage in view of establishing the connection of computing mechanism are rendered inoperative due to the movement instituted by any one of the slides 136.

During the movement towards the left of one of the slides 136, a pin 143 of a disc 49, co-operating with said disc 136, is likewise and simultaneously carried along by means of the lower boss 138. A rotary movement of the corresponding disc 49 in counter-clockwise direction is induced hereby, causing the pin 51 to contact the corresponding rod 53 pushing same downwardly. The slot 54, engaging hereby the pin 55, which, in the succeeding operation of the computing mechanism, determines the operation of the computing mechanism, corresponding to the respective selective key.

The control of the balancing mechanism 16 is carried out in a similar manner as already described. The balancing mechanism 16 is supported on a frame 144, Fig. 1, which is mounted for oscillating movement about a shaft 145. The counting mechanism 16 can be connected to, or disconnected from the toothed segments 3 by means of a revolving disc 146. For this effect the revolving disc 146, which is fastened to a shaft 147, is swung in a counter-clockwise direction. Depending upon whether the struck figure shall appear in the balancing mechanism 16 additionally or subtractively, the upper or the lower set of wheels respectively of the counting mechanism 16 engages the tooth segments. The position of engagement of both sets of wheels of the counting mechanism 16 is determined by the position of a second frame 148, arranged within the oscillating frame 144, the second frame carrying the shafts 350, 351 of the counting wheel, Fig. 8 The control of the frame 148 is not a part of the present invention and therefore is not further described. This control is clearly disclosed and shown in application Serial No. 181,440.

As shown in Fig. 4 a lever 149 is fastened to the shaft 147 which carries the revolving disc 146, said lever being pivoted at 150 to a link 151.

The left end of the link 151 is connected to a control anchor 153 by means of a journal 152, the arrangement, disposition and operation of said anchor being the same as those of the control anchor 88 already described. The machine, according to the present embodiment, is thus provided with two anchors, one anchor 153 for the balancing mechanism 16 exclusively and an anchor 88 for the control of the computing mechanism, which is situated underneath the toothed rack 19. The anchor 153 carries pawls 154, 155, 156, which are held in the position shown in Fig. 4 by means of springs 305, 304, 191. The operation of the pawls 154, 156 is however different from that of the pawls 93, 95 of the anchor 88.

The balancing mechanism 16 or the anchor 153 respectively is provided with distinct keys 157, 193, 194 for the operating method and which are independent from the operating method keys 105, 124, 126 of the computing mechanism. The summing-up key or totalizing 157 of the balancing mechanism is connected by means of its key shaft or rod 158 to a lever 160 oscillating about the journal 159 as also to a cranked lever 162 oscillating about the journal 161. On pushing down the summing-up key 157 of the balancing mechanism the levers 160 and 162 are swung about in clockwise direction. The lever 160 carries two pins 163, 164 of which pin 163 acts upon the pawl 154 while pin 164 is gripped by a lever 165.

It is thus to be seen, that swinging motion of the lever 160 determines, in co-operation with the pin 163, a rotary movement of the pawl 154 in clockwise direction and furthermore, in co-operation with the pin 164, a swinging movement of the lever 165 in counter-clockwise direction, thereby causing pawl 155 to swing in clockwisc direction over a pin 166 about the pivot 214.

On pushing down the summing up key 157 of the balancing mechanism, the pawl 154 will thus be brought within reach of the pin 98 while pawl 155 is removed out of the path of this pin. The pins 98 and 97 are so formed that they can cooperate with the pawls 93, 94, 95 of the control anchor 88 as well as with the pawls 154, 155, 156 of the control anchor 153. The swinging motion of the lever 162 results in a movement towards the left of a rail 167 which is pivotally connected at 168 to the lever 162. The right end of the rail 167 is pivotally connected in 168 to a two-armed lever 169. The two-armed lever 169 is mounted for oscillation movement about the pivot 170 on the machine frame. The upper end of the double-lever 169 rests against a pin 171 which is fastened to a link 172. A pawl 174, having a tendency of being swung by a spring 175 in clockwise direction, is mounted for swinging movement about a pivot 173 on the link 172.

The link 172 is formed with a slot 176 into which extends a pin 178 fastened upon a double-

armed lever 177, which latter is mounted for swinging movement about a pivot 179. A spring 180 between lever 177 and link 172 has a tendency of swinging the lever 177 in clockwise direction until the pin 178 contacts the right hand end of the slot 176. A pawl 181, mounted for swinging movement on a pin 178, is moved in clockwise direction by a spring 182. Both pawls 174, 181 co-operate with a pivot 183 of a lever 185 fastened to a shaft 184. The shaft 184 is used in connecting the driving motor which is not shown. Loosely connected to the pin 178 is a rod 186 which cooperates with a slide 187 for controlling the co-operative operation of the machine while posting positive or negative sums such as described and shown in application Serial No. 181,440.

A link 189, carrying a pin 190 is pivotally connected at 188 to the lower arm of the two-armed lever 177. The pin 190 maintains the pawl 156 out of engagement with the pin 97 against the action of its spring 191.

On pushing down the summing-up key 157 of the balancing mechanism, the parts 162, 167, 169, 171, 172, 180, 177 of the links 189 are shifted towards the left against the effort of a spring 192 (Fig. 4), whereby the pin 190 releases the pawl 156 thus allowing the latter to be swung about its pivot 215 by the spring 191 into the operating path of the pin 97. After releasing the summing-up key 157 the said parts are returned by the spring 192 into non-operative position shown in Fig. 4. It is thus to be seen that during the forward movement of the machine drive, the pin 97, in co-operation with the pawl 156 shifts the anchor 153 towards the right, (Fig. 4), whereby the balancing mechanism 16 is brought in engagement with the toothed arcs 3, over link 151 and lever 149 by means of the revolving disc 146. At the end of the forward movement of the machine drive the pin 98 contacts pawl 154 and thereby returns the anchor 153 in its non-operative position, disconnecting anew the counting mechanism 16.

In carrying out postings of intermediate sums and non-adding operations of the balancing mechanism 16, the intermediate summing-up key 193 and the non-addition of the balancing mechanism are used to correspondingly control the control anchor 153 in an appropriate manner such as described heretofore in connection with the intermediate summing-up key 124 of the computing mechainsm and the non-adding key 126 respectively, in connection with the control anchor 88.

Setting of the balancing mechanism for summing-up, posting of intermediate sums and non-addition operations can also be effected automatically by means of an appropriate carriage control. To this effect control elements 39 are placed in certain slots 38 of the control element holders 37. These control elements co-operate with cranked levers 41 to which are fastened pulling wires 197, 198' The pulling wire 197 is fastened to a cranked lever 199 and the pulling wire 198 to a cranked lever 300. Both levers 199, 300 are mounted on a common shaft 301. Mounted on the cranked lever 199 is a link 302, the left end of which is connected to the lever 165 by means of a pivot 216. The lower arm of the lever 300 is connected to the link 172 by means of a pivot 303.

When a control element is placed in the slot 38 of the control member holders 37 corresponding to the non-addition operation in a certain columnar position of the paper carriage 24, the pulling wire 197 is moved upwardly over lever 41 (Fig. 4), whereby the lever 165 is swung about pivot 200, in counterclockwise direction over the parts 199, 302. The lever 165 thereby moves the pawl 165 against the action of the spring 304 out of reach of the pin 98. The pawl 154 is swung against the effort of the spring 305 in clockwise direction about the pivot 201, by means of the pin 163 of the lever 160 and the pin 164 into its operative position, yet this swinging motion of the pawl 154 remains without effect upon the control of the anchor 153 because the latter has not been moved towards the right and the pin 98, consequently, cannot come within reach of the pawl 154.

In thus setting a control element 39 in a corresponding position, the balancing mechanism 16 is automatically adjustable to a certain columnar position of the paper carriage.

If a sum is to be posted or set up automatically from the balancing mechanism 16 in a certain columnar position, two control elements 39 for the corresponding columnar position of the paper carriage must be set in the slot 38 of the control element holders 37 corresponding to the non-addition and the sum.

By means of one of the control elements 39, similarly as decribed heretofore in connection with the non-addition operation, the pawl 155 is automatically swung out of the path of the pin 98 while pawl 154 is moved into the path of the pin 98. The other control element 39 determines in the corresponding columnar position of the paper carriage 24 an upward movement of the pulling wire 198, (Fig. 4), whereby the link 172 is moved over the lever 300 into the position shown in Fig. 5. The movement toward the right of the lever 172 over the parts 180, 177, 189, similarly as described hereabove, has for result the release of the pawl 156 which, due to the effort of spring 191, moves into the path of the pin 97, (Fig. 5).

At the beginning of the operation, the pin 97, on shifting of the anchor 153 toward the right, moves the balancing mechanism 16 in operating position, while at the end of the advancing operation of the machine drive, the pin 98 moves on its movement toward the left of the anchor 153 the balancing mechanism out of operative position by means of pawl 154. The balancing mechanism 16 is thus automatically set on total.

If in a certain columnar position, only one control element 39 is placed in the slot 38 of the control element holder 37 corresponding to the posting of a sum, the pawl 156 is swung into active position. The pawls 155, 154, remain in the position shown in Fig. 4.

The pin 97 thus sets the balancing mechanism 16 to begin of the advancing movement of the machine drive by means of the pawl 156 on movement towards the right of the anchor 153, and the balancing mechanism is disconnected only at the end of the rearward movement of the machine drive on contacting of the anchor 153 with the surface 202 and shifting towards the left of the anchor 153. The balancing mechanism is consequently automatically set to intermediate sum.

The machine according to the present embodiment is provided with an arrangement to ascertain the prefix of the contents of the balancing mechanism. A pair of wheels 353, 352 (Fig. 8) is mounted upon the shafts 351, 350, of the balancing mechanism 16 laterally of the counting

wheels corresponding to the position of the highest value. The pair of wheels 352, 353 is set from the position of the highest value by means of a control device for tens, which is not shown, always then when all of the counting wheels of the balancing mechanism 16 pass through zero. On the right lateral wall of the frame 148 oscillating about the shaft 354, is a pin 355 which engages the lower wheel 353 at a point in which one of the teeth is cut out. The pin 355 therefore allows only a forward or rearward movement of the pair of wheels 352, 353, corresponding to the value of one tooth.

The wheels 352, 353 are provided with lateral teeth 356, 357 for the control device of tens, said teeth being positioned opposite protruding parts 358, 359 on pawls 360, 361. The upper pawl 360 is mounted for rotary movement upon a shaft 362 and contacts with its upwardly projecting arm 363 a cranked lever 364 (Fig. 9). The cranked lever 364 is mounted about a pin 365 situated in a bent-off portion 366 of the oscillating frame 367 of the counting mechanism. A connecting rod 368 is mounted for oscillating movement on a cranked lever 364 and has its free end connected to an arm 370, which is adapted to oscillate about a shaft 369 by means of a pin 371 (Figs. 10, 11).

The arm 370 is connected to a two-armed lever 373 by means of a bridge 372. The shaft 369 is mounted on a U-shaped plate 375 which is fastened to the machine frame 374. A spiral spring 376 is disposed on shaft 369. The spring 376 has a tendency to swing the arm 370 in counter-clockwise direction whereby a pressure is exerted in clockwise direction upon the cranked lever 364.

The setting of the balancing mechanism 16 according to Fig. 1, 8 corresponds to the position of addition. The position of the teeth 356 of the control mechanism for tens of the upper wheels 352 beneath the raised portion 358 of the control pawl 360 corresponds furthermore to a positive content of the counting mechanism.

When the balancing mechanism 16 is reversed, in a manner not illustrated, either by means of a key or automatically, into subtracting position, this operation is effected by swinging the frame 148 about its shaft 354, this without that rotation of the wheels 352, 353, takes place in respect of the shafts 350, 351. On shifting the balancing mechanism 16 by means of the revolving disc 146 (Fig. 1), the upper set of wheels of the balancing mechanism 16 engages the toothed segments 3.

If now an amount is subtracted which is greater than the contents obtaining in the balancing mechanism 16, a setting to the position of the highest numeral is effected by means of a device for setting tens, as in this case the counting device has been "over-drawn." The wheel 351 is hereby carried along about one setting step in a normal manner by means of the setting device for the tens which is not shown, from the value of the highest position situated next to the counting device. The setting tooth 357, which, in the position of subtraction of the balancing mechanism 16 having a positive content, is situated slightly above a raised portion 359 of the setting pawl 361, swings the setting pawl 361 about its shaft 377 toward the right, as soon as the contents of the balancing mechanism become negative, (Fig. 8). During its swinging motion toward the right the setting pawl 361 carries the pawl 360 along on its contacting surface 378, the pawl 360 itself swinging the cranked lever 364 against the effort of the spring 376, in a counter-clockwise direction. The connecting rod 368 hereby swings the arm 370 and the two-armed lever 373 in a clockwise direction.

The lower arm of the double-armed lever 373 carries the right hand end of the rod 186 (Fig. 4), which is usually guided in the lever 373, so that it may freely shift to the right and to the left when the lever 177 is adjusted.

On swinging the lever 373 in the above-mentioned manner perpendicularly to the plane of the drawing (Fig. 4), the rod 186, which is guided by the lever 373, is likewise swung in a perpendicular direction to the plane of the drawing. The movements of the rod 186 to the right and left are thus controlled in such manner that the rod 186 will co-operate in a certain manner with the recesses 217 formed in the slide 186. This co-operation of the rod 186 and the slide 187 serves for controlling the machine to automatically carry out zero-settings before summing-up operations. This control is not an object of the present invention and is therefore not more precisely described and illustrated, but is fully disclosed in the application Serial No. 181,440.

A lever 379 can be fastened to the pin 371, (Figs. 2, 3, 9) this lever being capable of being swung by means of a screw-bolt 380 which is fastened to the machine frame.

The lever 379 is formed at its front end with a bent-over portion, not shown, which is marked with a plus and a minus sign. The respective prefix of the contents of the balancing mechanism can be indicated by means of the swinging motion of the lever 379 which is controlled by the connecting rod 368, similarly as described in application Serial No. 181,440.

The double-armed lever 373 carries at its upper arm a pin 400, to which a connecting rod 401 is pivotally connected, (Figs. 6, 10, 11). A link 402 is movably connected to the connecting rod 401 by means of screws 403. The link 402 is fastened to a cranked lever 404 by means of a pivot 218 (Fig. 2). The cranked lever 404 is mounted for oscillating movement upon a shaft 405 and is connected to a connecting rod 406. The other end of the connecting rod 406 is fastened to a lever 41 which is adapted to be swung by means of a control element 39 disposed on the paper carriage 24.

The link 402 is provided with a boss 408 which is adapted to selectively co-operate with one of two journals 409, 410, (Fig. 6).

The journals are fastened to two armed levers 411, 219 which are mounted for rotating movement on a shaft 412. Each of the lower ends of both levers 411, 219 is connected over a link 413 to a two-armed lever 414. The two-armed levers 414 are mounted for oscillating movement on shaft 44 and joined at their lower end to one of the connecting rods 47 in view of effecting setting of the counting mechanism.

The connection between the two-armed levers 414 and the connecting rods 47 is carried out in exactly the same manner as the connection between the discs 43 and the connecting rods 47, the latter being actuated directly by means of the pulling wires 42 and the control element 39 disposed on the paper carriage 24.

As has been described hereabove the position of the two-armed lever 373 is dependent on the prefix of the content of the balancing mechanism. When this content is positive the two-armed lever 373 is in the position shown in Fig. 6, and, if negative, in the position shown in Fig. 7. The exten-

sion **408** of the link **402** is consequently coupled to the journal **409** by means of the connecting rod **401** if this content is positive, and to the journal **410** is the content is negative. If in a predetermined columnar position of the paper carriage **24** a control element **39** is placed in a corresponding slot **38** of the holders **37** of the control elements, the control element **39** of the levers **41** will swing out and thereby move the pulling wire **406** in Fig. 2 upwardly. The link **402** is thereby moved over the angular lever **404** toward the right in Fig. 2. Corresponding to its setting depending on its respective prefix of the contents of the balancing mechanism, the extension **408** of the link **402** engages either the journal **409** or the journal **410**, and the computing mechanism **17** or the computing mechanism **18** will be automatically brought into engagement with the toothed racks **19** by the paper carriage over the parts **413**, **414**, **47**, **49**, **53**.

If in a same columnar position of the paper carriage two control elements **39** are also set to automatically adjust the machine to summing-up, the computing mechanism **17**, **18** which are automatically selected by means of the links **402**, take up separately from the balancing mechanism **16** the sums automatically set according to prefixes.

It is obvious that any computing mechanism of the machine may be selected by means of the link in accordance with the prefixes of the balancing mechanism, such selection being not limited to the computing mechanism **17**, **13**. The computing mechanism which are adapted to be set in operative position might as well be selected by the link **402** on rotating the shafts **66**, **67**.

If on actuating in the usual manner a horizontal motor key or a skip-key, not shown, the paper carriage **24** is set in the columnar position which is predestined for summing-up, the sum is automatically thrown out from the balancing mechanism, and posted, and at one and the same columnar position of the paper carriage, the positive sums are entered in one, and the negative sums in another computing mechanism without any co-operation of the bookkeeper. As the positive and negative sums are also posted in one and the same column, they must necessarily be differently characterized which may be done in the usual manner by imprinting in different colors or in simultaneously imprinting certain signs. It is obvious, without departing from the scope of the invention, that instead of one, several balancing mechanism may be present. In such case each of these balancing mechanism controls a selecting device for the computing mechanism corresponding to the prefix of its contents.

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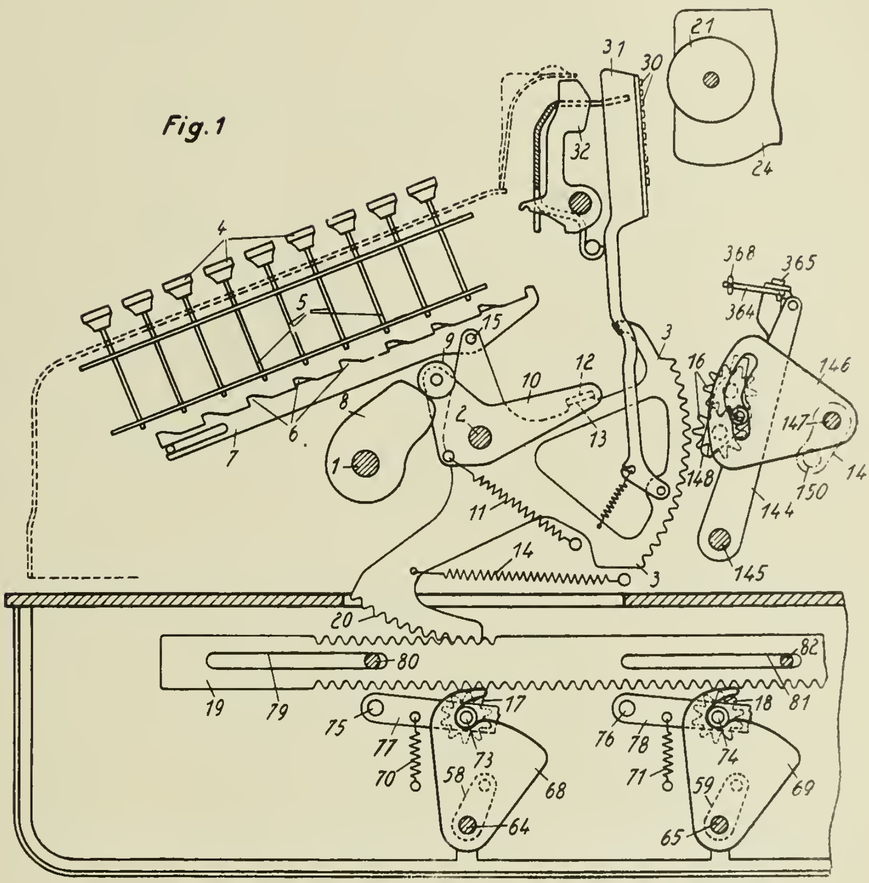
7 Sheets-Sheet 1

Fig. 1



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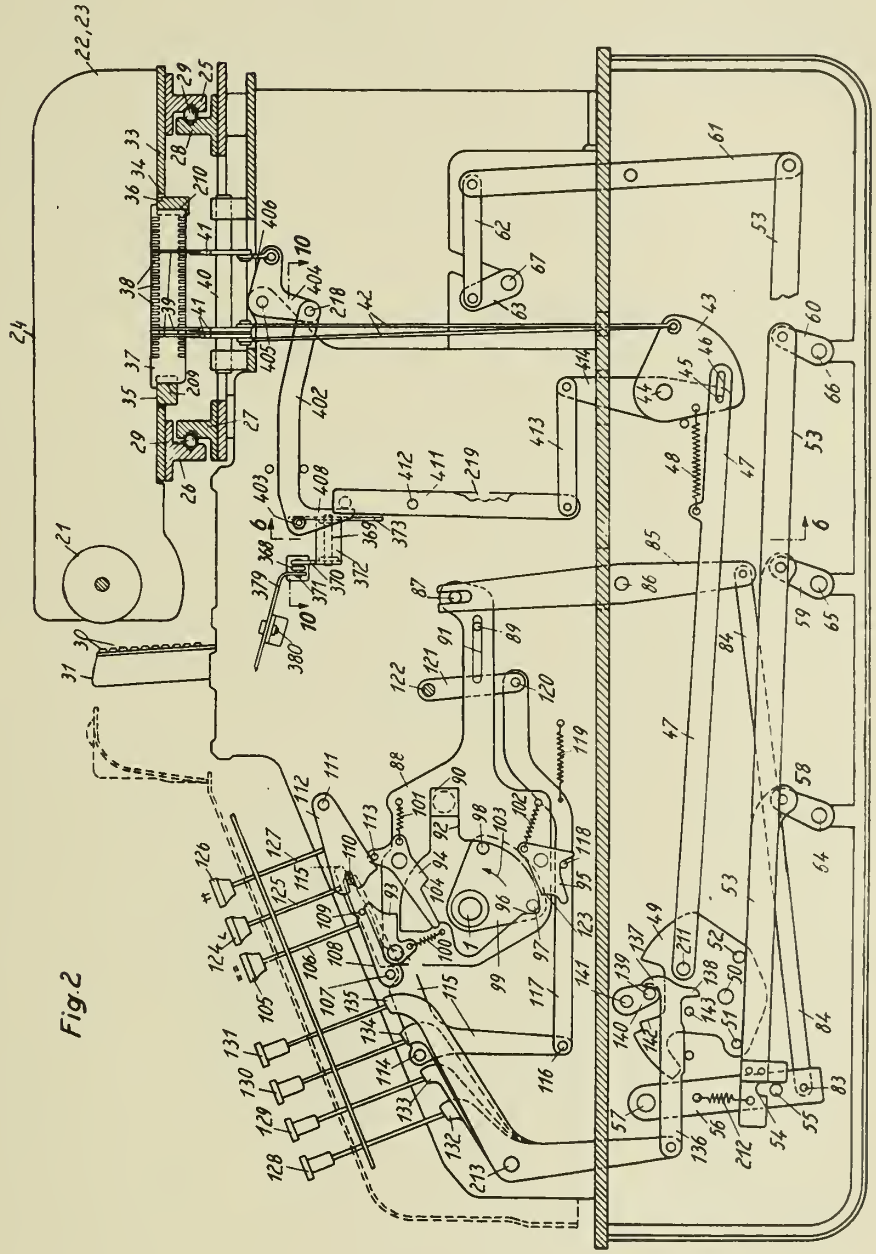

Fig. 2

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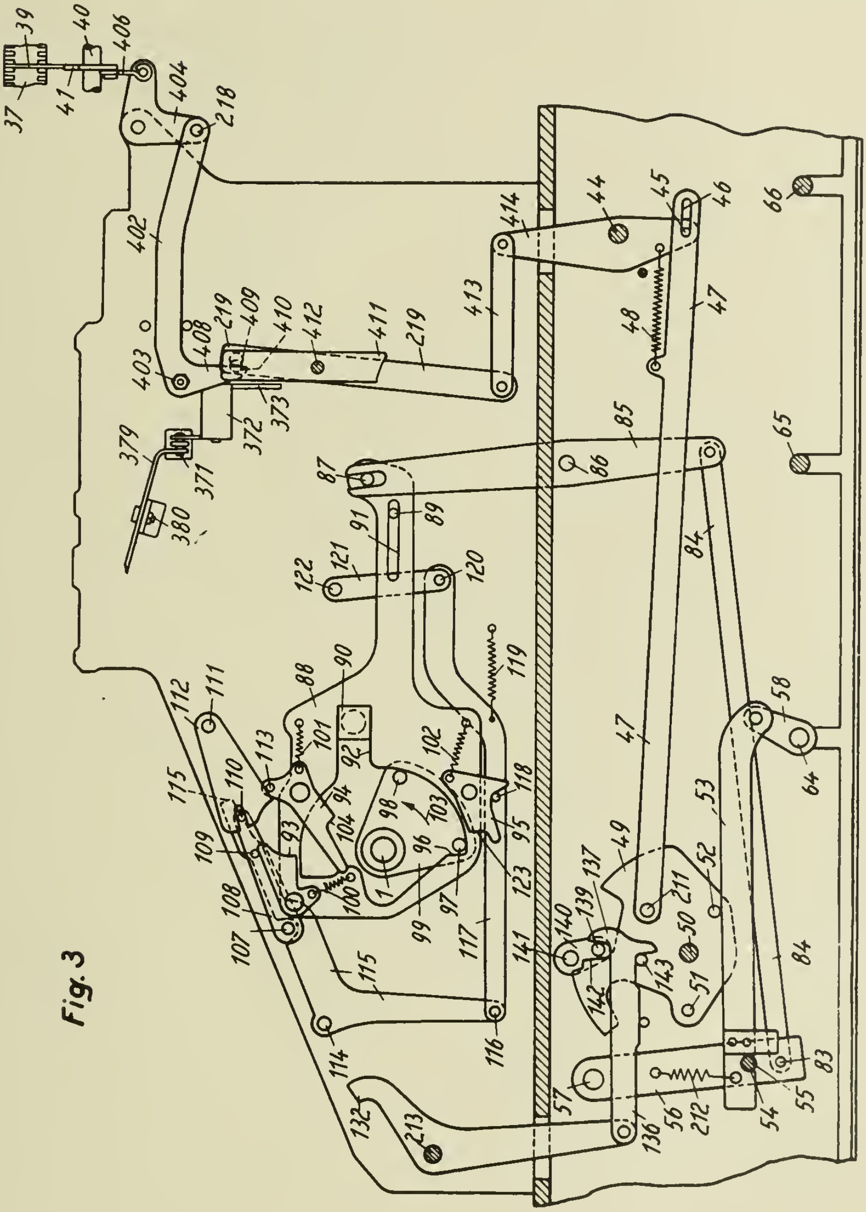

Fig. 3

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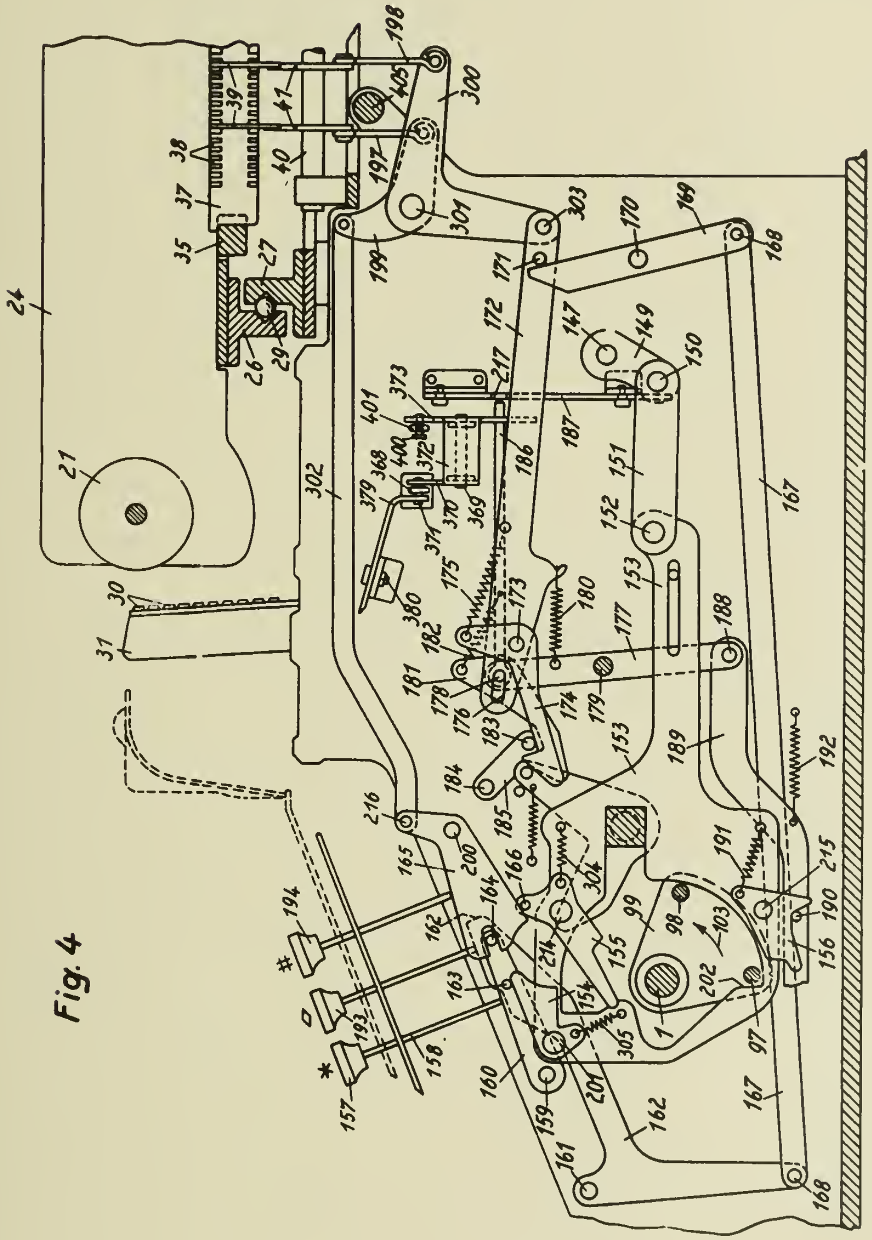

Fig. 4

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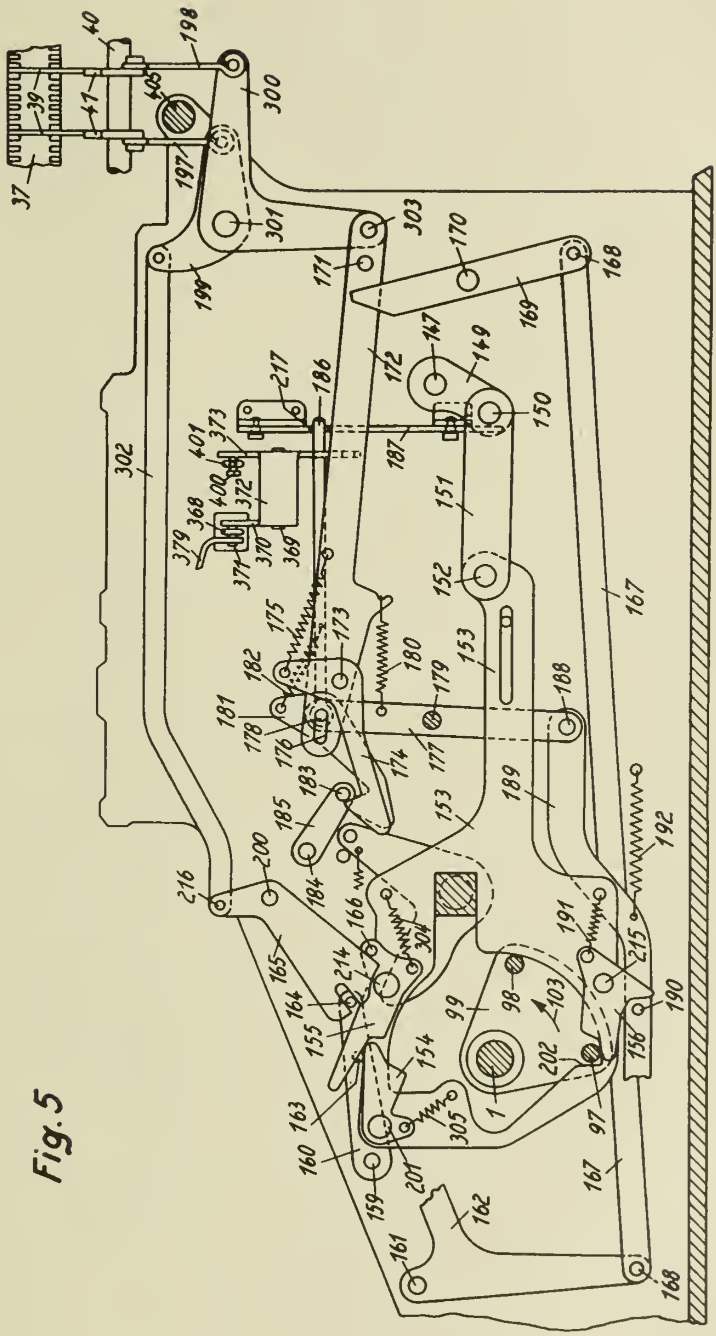

Fig. 5

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Fig. 6

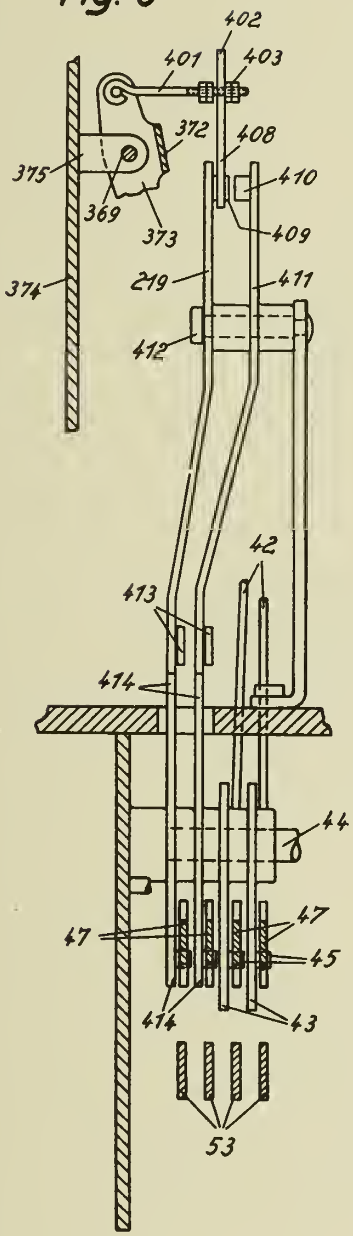

Fig. 7

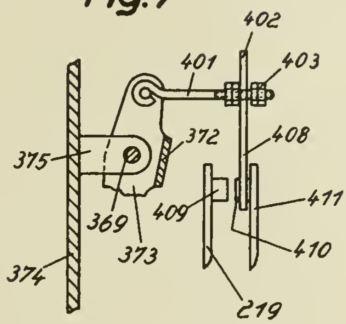

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Fig. 8

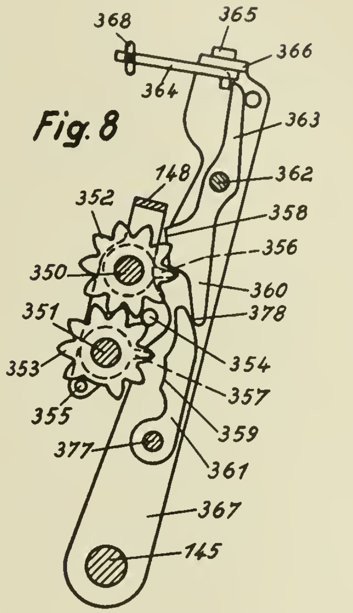


Fig. 9

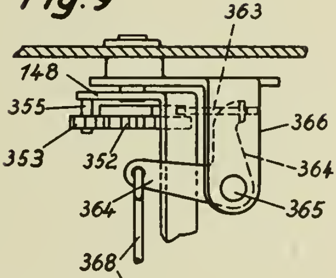


Fig. 10

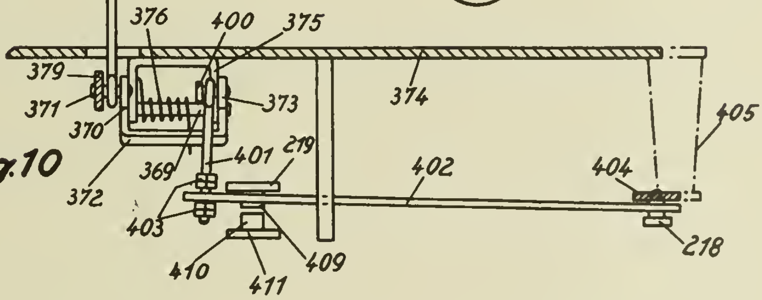
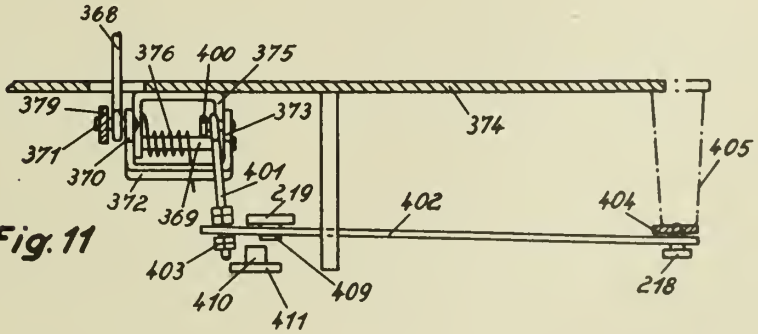


Fig. 11



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ALIEN PROPERTY CUSTODIAN

INTERNAL COMBUSTION ENGINES

Fritz Egersdörfer, Berlin, Germany; vested in the Alien Property Custodian

Application filed August 30, 1938

My invention relates to improvements in internal combustion engines, and more particularly in the means for supplying pre-compressed air for supporting combustion and scavenging. One of the objects of the improvements is to provide an engine of this type in which air for producing the combustible mixture and for scavenging may be supplied at high pressure say of four atmospheres and more, by means of a small pump which is driven from a rotary part of the engine, and which requires little space, so that it may be readily associated with the engine. Another object of the improvements is to provide an engine in which the pump for supplying the air may be driven at very high speed such as 24,000 per minute, and in which notwithstanding this high velocity the pump has a high volumetric efficiency, and in which loss of air from the pump is avoided.

Another object of the improvements is to provide an engine which may be readily controlled by varying the amount of air supplied by the pump.

Further an object of the improvements is to provide an engine in which the means for supplying the said air under pressure are simple in construction and consist of a comparatively small number of elements which require little attention by the engineer.

With these and other objects in view my invention consists in combining the engine with a gear pump for supplying the said air under pressure which pump comprises interengaging gear wheels compressing the air and supplying the same to the cylinder or cylinders of the engine, the said pump being connected with a suitable rotary part such as the crank shaft of the engine through a transmission gearing having a high gear ratio of say 1 to 6, so that the number of revolutions of the pump is a multiple of that of the driving element. For regulating the volume of air supplied by the pump a valve or gate is provided in the suction pipe of the said pump.

The air pump is preferably associated with a fuel pump which is controlled in dependence of the pressure of the air delivered from the pump.

My improved system may be used in connection with two-stroke and four-stroke cycle internal combustion engines.

For the purpose of explaining the invention two examples embodying the same have been shown in the accompanying drawings in which the same reference characters have been used in all the views to indicate corresponding parts. In said drawings

Fig. 1 is a diagrammatic elevation partly in section showing a four-cylinder internal combustion engine having the air supplying pump and other parts associated therewith,

Fig. 2 is a sectional elevation showing the pump,

Fig. 3 is a sectional elevation taken on the line **3—3** of Fig. 2,

Fig. 4 is a sectional plan view taken on the line **4—4** of Fig. 3, and

Fig. 5 is a sectional elevation similar to the one illustrated in Fig. 2 and showing a modification.

Referring at first to the diagrammatical elevation shown in Fig. 1, a four-cylinder internal combustion engine *a* is associated with a gear pump *b* for supplying air under high pressure of say four atmospheres or more for producing the combustible mixture and for scavenging, the said gear pump being connected with the crank shaft *i* of the engine by a transmission gearing *c* transmitting power at the gear ratio of 1 to 6, so that the number of revolutions of the pump is six times that of the said crank shaft. The said gear pump delivers air under pressure through a pipe *d* and a wind chest *e* into the manifold of the internal combustion engine. The suction conduit *k* of the pump is provided with a throttle valve *m* for regulating the volume of air delivered by the pump.

As is shown in Figs. 2 to 4 the gear pump consists of a cylinder **6** formed with cooling ribs and closed at its ends by heads **7** and **8**. Within the cylinder there are two gear wheels **9** and **10** which are mounted on shafts **11** and **12**. The gear wheel **9** is fixed to the shaft **11** by means of a feather **13** permitting axial displacement of the gear wheel on the shaft. The shaft **11** is mounted in bushings **14** the diameter of which is equal to the outer diameter of the gear wheel, and the said bushings are likewise loosely mounted within the cylinder **6**. Thus the bushings set themselves with their outer end faces flush with the end faces of the cylinder **6**, and their inner end faces are in loose engagement with the end faces of the gear wheel **9**. The gear wheel **10** is rotatable on the shaft **12**, and the said shaft is fixed in bushings **15** the outer diameter of which is equal to that of the gear wheel **10**, and the said bushings are formed with segmental recesses accommodating the adjacent portions of the bushings **14**. Also the gear wheel **10** and the bushings **15** are floating within the pump casing. Thus the gear wheels are free to set themselves within the casing so that there is no wedging

of the parts though the bearings of the shafts have close fit within the casing.

The driving shaft **11** is driven through a toothed gearing **16** from a driving shaft **17** which is connected by means of the transmission gearing *c* with the crank shaft of the engine.

In the suction passage **18** of the pump there are guide plates **19** by means of which the air has a gradual and smooth flow to the gear wheels. When such guide members were not provided the air would intermittently flow to the spaces between the teeth of the gear wheels **9** and **10**, which would cause a strong noise. Within the pressure chamber **20** there is a spring pressed valve **21** which prevents the air delivered from the spaces between the teeth of the gear wheel from returning from the pressure conduit to the pressure chamber **22**.

The modification shown in Fig. 5 is similar in construction to the gear pump shown in Figs. 2 to 4, and the same reference characters have been used to indicate corresponding parts. As distinguished from Figs. 2 to 4, the gear wheels **9** and **10** are connected with gear wheels **23** and **24**, the gear wheel **10** is connected with its shaft **26** by a feather **25**, and the said shaft is rotatably mounted in antifriction bearings **27** fitted in the bushings **15**. The gear wheels **23** and **24** are set so that they are able to take up the moment transmitted from the driving shaft **17** to the shaft **26**, so that the pressure of the teeth of the gear wheels **9** and **10** is not higher than is needed for tight engagement of the teeth. Thus the friction between the gear wheels **9** and **10** is reduced substantially to zero so that the gear wheels do not run hot. The teeth of the gear wheels **23** and **24** are preferably disposed angularly of each other.

In the operation of the internal combustion engine the air is supplied by the gear pump *b* and, if desired, through a distributor or controlling device *f*. The intake valves of the internal combustion engine may be automatically controlled by means of the compressed air through the intermediary of the distributor. When the load of the engine is increased the throttle valve *m* provided in the suction pipe of the pump is opened for supplying a larger amount of air to the working cylinders. If it is desired for example to increase the velocity of the engine provided for example on an air craft, the throttle valve *m* is further opened, so that the amount of air and fuel supplied to the engine and thereby the velocity of the engine are increased. Preferably the gear wheels are provided with cooling chambers **29** to which cooling air may be supplied from without for example through bores **28** made in the shaft **17**.

The fuel injection pump *g* is controlled by means of a spring pressed plunger *h* in accordance with the air pressure within the chest *e*, so that the volume of fuel corresponds to the volume of air supplied to the engine particularly in case of operation of the engine with precompressed air.

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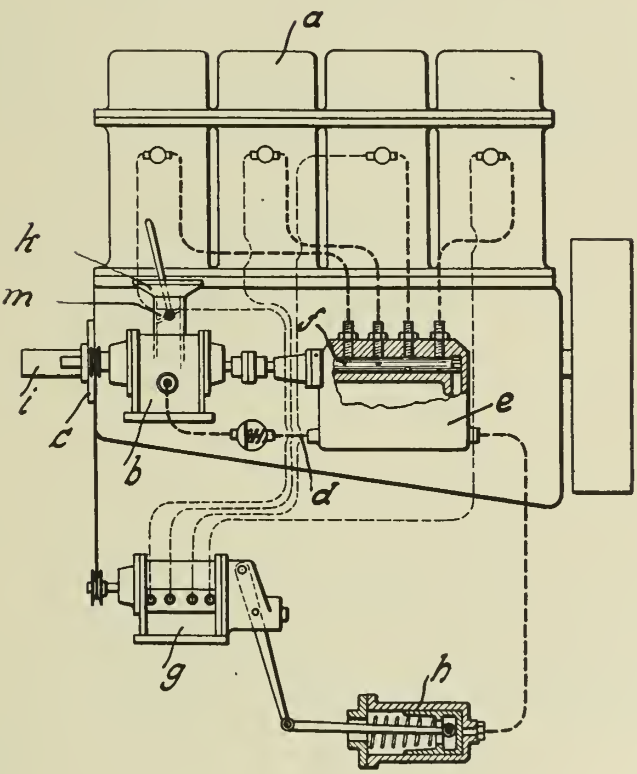

Fig. 1

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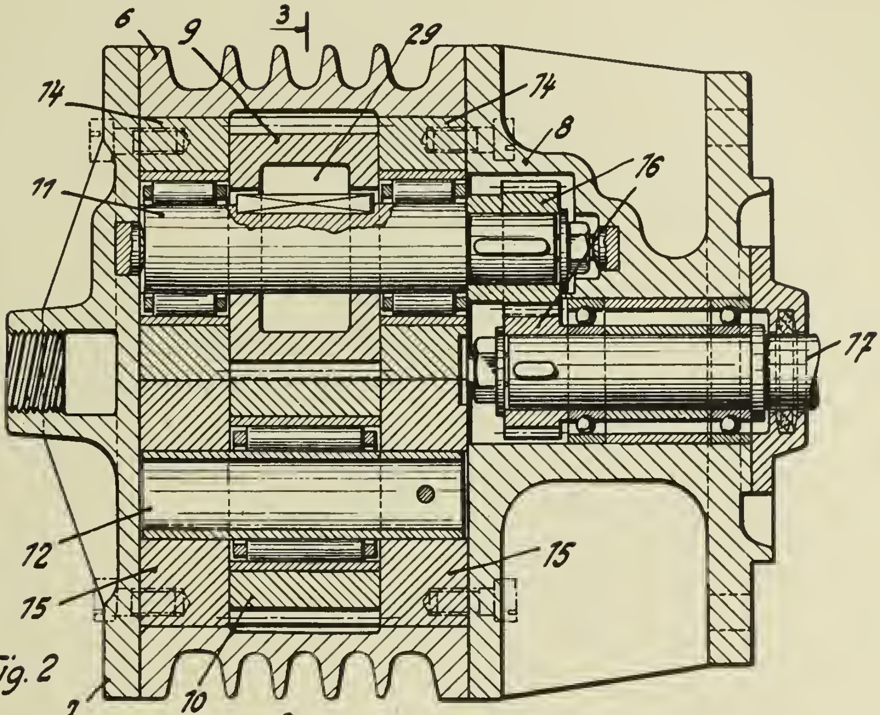

Fig. 2

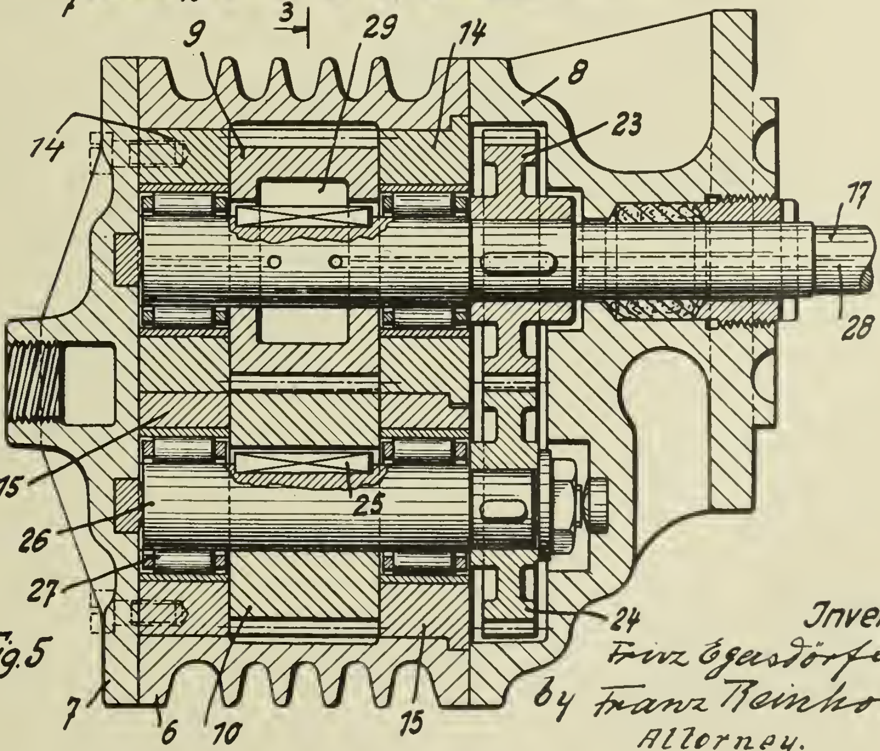

Fig.5

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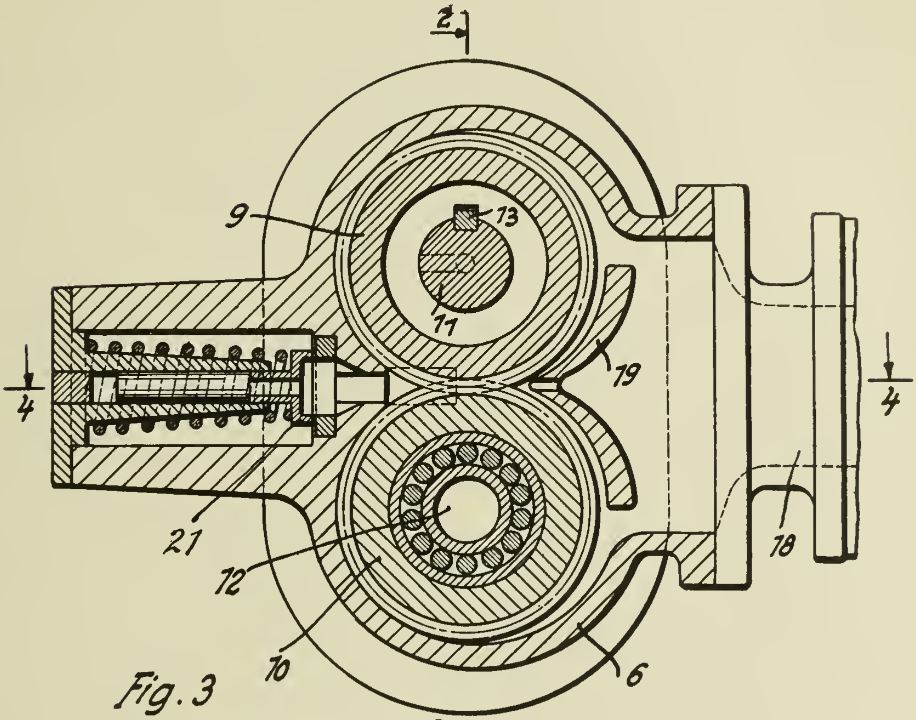

Fig. 3

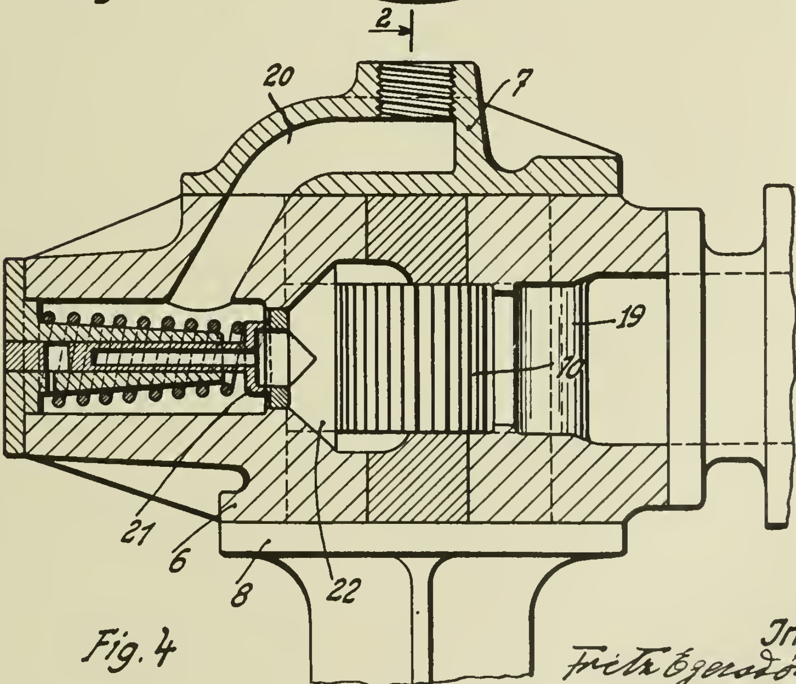

Fig. 4

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ALIEN PROPERTY CUSTODIAN

MULTIMOTOR AIRPLANE

Claude Dornier, Friedrichshafen A. B., Germany; vested in the Alien Property Custodian

Application filed September 27, 1938

The present invention relates to arrangement of motors and propellers in airplanes, more particularly to the location of said motors and propellers with respect to the fuselage and tail unit.

The arrangement of a plurality of powerful motors in high speed airplanes in which the specific wing pressure is very high represents a difficult problem to the airplane designer. It is desirable to reduce the support surfaces and particularly the width of the plane as much as possible. With the conventional method of mounting the motors on both sides of the fuselage the face of the fuselage and motor gondolas takes a considerable part of the total front face of the plane and makes a wide span necessary. This conventional arrangement causes considerable air resistance and also disturbance of air flow in the space between fuselage and motor gondolas.

It is an object of the present invention to provide a design for airplanes which has at least two powerful motors but in which there are no obstructions to air flow on the side of the fuselage and in which the wing span is relatively small. The present invention relates particularly to the design of an airplane having best aerodynamic conditions in spite of the provision of two powerful motors whereby bulky and heavy power transmissions which also cause reduction of power efficiency and the development of undesired torsional moments which development is usually connected with the provision of high power motors are completely eliminated.

It is an object of the present invention to provide an airplane having a fuselage to which the wings are connected and the rear end of which is adapted to carry the tail unit, said airplane being equipped with two powerful motors which are arranged behind one another in said fuselage, the forward motor driving a pull propeller and the rearward motor driving a push propeller the axis of rotation of which coincides substantially with the longitudinal axis of said fuselage.

It is known to place, in the airplane fuselage, two motors behind one another in so called tandem arrangement. In the conventional constructions, however, both motors drive two adjacent propellers which are disposed at the forward end of the fuselage or they both operate one propeller only. It is also known to arrange, in motor gondolas which are not used at the same time for carrying a tail unit, two motors in tandem arrangement of which the forward motor drives a pull propeller and the rear motor a push propeller. Airplane constructions are also known in which a propeller is arranged at the rear part of the fuselage either in the rear or in front of the tail unit whereby the bearing for the push propeller is embedded in the surface of the fuselage or surrounds the fuselage; this type of construction, whereby the heavy motor is comparatively close to the rear end of the fuselage, has not produced desirable results because the center of gravity is too far rearward.

An object of the present invention is to provide in the fuselage of an airplane a forward motor driving a pulling propeller and a rear motor driving a push propeller. With this arrangement weight and moment of torsion can be so equalized that a most satisfactory airplane operation is obtained.

Further and other objects of the present invention will be hereinafter set forth in the accompanying specification and shown in the drawings which, by way of illustration, show what I now consider to be a preferred embodiment of my invention.

In the drawings:

Figure 1 is a diagrammatic longitudinal sectional view of a fuselage of an airplane according to the present invention.

Figure 2 is a diagrammatic front view of a multimotor airplane according to the present invention.

Like numerals designate like parts in all figures of the drawing.

Referring more particularly to Figures 1 and 2 of the drawings, **10** designates the body or fuselage of the airplane to which the wings **11** and the tail unit comprising conventional elevator fins **12** with elevator rudders **13** fulcrumed thereto are connected. There are, however, two rudder units, an upper vertical stabilizer **14** with rudder **15** linked thereto and a lower stabilizer **16** with rudder **17** linked thereto. The pushing propeller **18** located at the stern of the fuselage necessitates this rudder arrangement whereby stabilizer **16** forms a suitable casing for the support **26** of the tail skid wheel **19** which in airplanes according to the present invention is farther away from the fuselage than usual. Two motors **20** and **21** of substantially equal weight and power are disposed in the interior of the fuselage **10**. The shafts **22** and **24** and propellers **23** and **18** connected thereto revolve in opposite directions so that the torsional moments are counterbalanced. The seat **25** of the operator is preferably arranged between the two motors **20** and **21**. Ample space is provided between the motors for the crew and instruments.

The power transmission from the motors to the

propellers 23 and 18 is mechanical by means of the shafts 22 and 24 respectively in the embodiment of my invention illustrated; other arrangements, for example, a pneumatic power transmission can be used whereby the motor drives a blower and the propellers are driven by reaction forces.

In large airplanes I may use a plurality of bodies built along the principles as shown in Fig. 1 and carrying wings and tail units.

While I believe the above described embodiments of my invention to be preferred embodiments, I wish it to be understood that I do not desire to be limited to the exact details of design and construction shown and described, for obvious modifications will occur to a person skilled in the art.

CLAUDE DORNIER.

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BY A. P. C.

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MULTIMOTOR AIRPLANE

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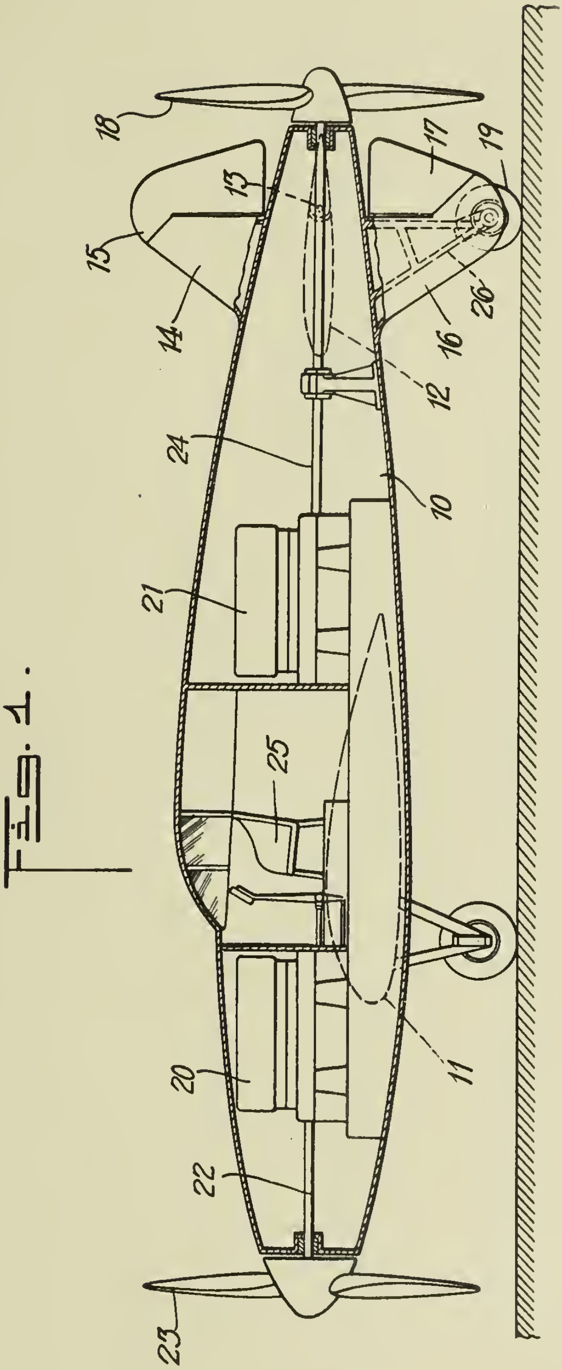

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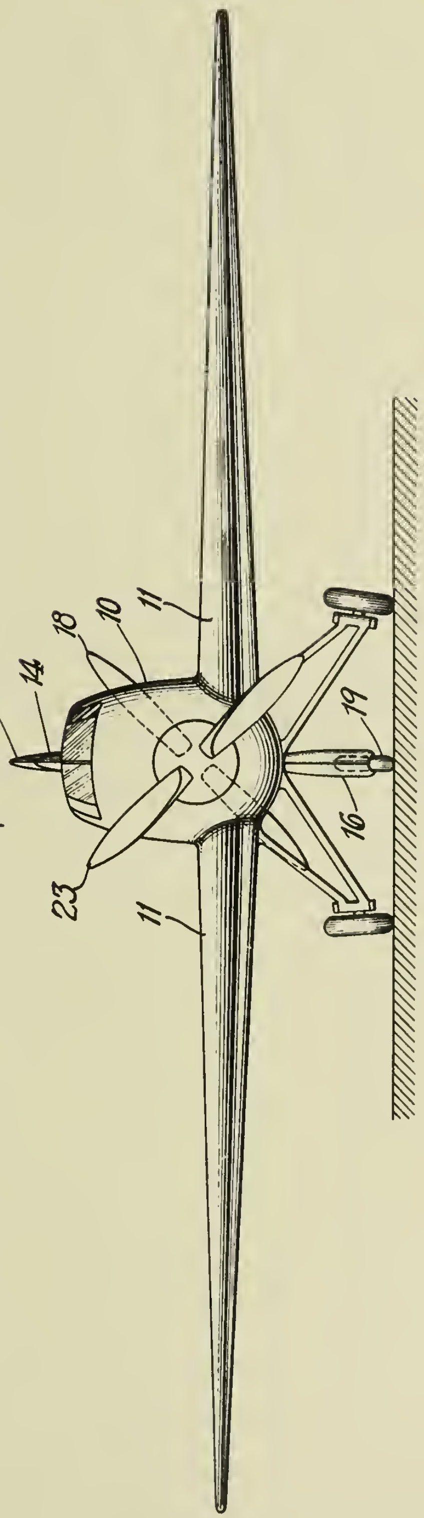
Fig. 2.



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Published May 25, 1943

Serial No. 232,236

ALIEN PROPERTY CUSTODIAN

PROCESS FOR HEATING SOLID, LIQUID OR GASEOUS BODIES

Bernhard Berghaus, Berlin-Lankwitz, and Wilhelm Burkhardt, Berlin-Grunewald, Germany; vested in the Alien Property Custodian

Application filed September 28, 1938

Electric energy is used for heating purposes in various ways. It is for example known in vacuum ovens to convert into heat electric energy in the form of ion bombardment on articles which for the most part are metallic. In this case the articles must be in electrically or thermally conducting connection with the cathode of the gas discharge. The portion of the current which is formed by the ions is available for the heating up and the converted energy on the cathode is a function of the voltage of the cathode drop and the ion stream. It has been found that the energy conversion takes place completely at the cathode if the "heating voltage" (termed in the German language "Brennspannung") of the gas discharge is equal to the cathode drop. If higher voltages than the cathode drop are applied as "heating voltage" to the discharge path then already a part of the energy, and in fact that derived from the total current and the voltage difference between cathode drop and "heating voltage", is converted into heat in the gas space, which heat is lost for the heating of the cathode. The efficiency of the cathodic heating consequently becomes worse with increasing output of the gas discharge and for certain cathode materials, as experiments have shown, becomes even very unfavourable.

The present invention relates to a process for heating solid, liquid or gaseous bodies which is characterised by the feature that the solid, liquid or gaseous bodies are heated in the space between the glow fringe and the anode of a glow discharge in which the energy supplied exceeds the product of normal cathode drop and normal current strength. The pressure of the gas is preferably adjusted to between 0.05 to 10 mm. of mercury. The "heating voltage" on the discharge path is chosen higher than the cathode drop. In practical operation voltages exceeding 7000 volts have been found not to be necessary. The current load of the cathode material is chosen higher than that which corresponds to the normal cathode drop. As cathode material preferably copper, iron, aluminium, elektron, or a light metal alloy is used. The electrode is introduced into the vacuum vessel insulated, cooled and screened. The cooling is necessary, for on the one hand the insulation material is to be protected from heat, and on the other hand because higher powers can be applied than those which would result in the fusion of the cathode material without cooling. The screening off of the cathode is effected according to use in such a way that between the two electrodes a gap is left which is smaller than the glow fringe forming about the cathode. For example, according to the pressure adjusted and the nature of the filling gas as well as of the applied voltage, distances of 5 to 0.1 mm. have proved to be suitable. It has been found to be particularly advantageous to make the space ring shaped. The length of the space is so chosen that charge carriers or particles disintegrated off the cathode can no longer reach the insulation material arranged as continuation of the gap. This requirement has been fulfilled particularly by means of a gap of labyrinth form, which prevents the direct path of the charge carriers or particles disintegrated off to the insulating material. The insulator is preferably arranged outside the vacuum vessel and the introduced electrode, which may be anode, if the vessel is cathode, and vice versa. If the vessel is connected to no voltage pole then it charges itself up almost to anode potential, as a result of which the same screening off is obtained with respect to the introduced electrode. The length of the necessary screening gap can be produced by placing metallic or non-metallic sleeves on. The screened-off lead-through element however may also be constructed as holder and current lead in for a cathode or anode of any shape or form. Also several screening-off sleeves with differently applied potential may insulatingly surround the electrode or current lead in. In this way either higher voltages or higher pressures may be adjusted in the discharge chamber with operative certainty. In order to raise the tension strength the current lead in may also be surrounded in addition by an insulator, e. g. glass, quartz, porcelain, and so forth, which is surrounded at the described distance by the metallic screening. As cathode for the heating of the vacuum chamber the insulated introduced electrode may be used with a metallic vacuum vessel as anode or with a separate anode. A metallic vacuum vessel may also be used as cathode and the insulated introduced electrode as anode. The applied voltages may be direct voltages or alternating voltages of various frequencies. If the electrode surfaces are favourably chosen (small anode in opposition to a large cathode) a rectifying effect can be produced at the same time when using alternating voltage.

Experiments have shown that the distribution of output between the energy liberated at the cathode and that of the gas space becomes greater and greater the higher the total energy of the discharge path is chosen. In order to make this output rise on the cathode possible

it is necessary to protect the insulating material from ion bombardment and metal which is disintegrated off, as well as from heat, since otherwise it will no longer stand up to the high specific outputs. For the introduced cathodes protected thus, which permit of an energy increase up to 100 watts per square centimetre and more with operative certainty, it was found, as is apparent from Figure 1 of the accompanying drawings, that with increasing load per square centimetre a very great portion of the output was in the gas space; that is to say the higher the gas discharge output is chosen, the more energy from the total output is liberated in the gas space. Moreover, as is apparent from the curves, there is also a considerable difference in the division of this energy for different materials. Thus it is apparent for example that for magnesium or a light metal alloy such as elektron, as cathode material the fraction for the gas space is particularly favourable. From this it can be inferred that the output division for the gas space is always better the more powerfully the cathode material is able to emit electrons. This was confirmed when oxidised light metals were used as cathode. Since light metals are particularly sensitive towards oxygen the output division in the case of some oxygen gas addition to the filling gas was substantially improved in favour of the gas space by the resulting oxidising effect. The heat liberated in the vacuum oven may be used for chemical, physical, and metallurgical purposes, thus for example for heating gases, vapours and liquids for chemical reactions or for heating articles in vacuum for the purpose of drying or degassing, or for annealing and melting metals or other substances.

In the accompanying drawing the invention is shown schematically in some detail with reference to one constructional example, Figure 2 showing a section through an apparatus for carrying out the process described.

The apparatus consists of a lower part **1** and a hood-shaped upper part **2**. In the lower part the cathode **3** is insulated and is arranged screened by a narrow labyrinth-like gap. The cathode, carrying a screen **3***a*, is constructed as a hollow body and through the lead **4** a cooling medium may be supplied and led off through the connection **5**. The part **6** is an insulating ring and the part **7** is an insulating and pressing-on ring. The vessel may be evacuated through the pipe connection **8** by means of a vacuum pump (which is not shown) to the desired pressure lying about between 10 mm. to 0.1 mm. of mercury. Through the pipe connection **9** a filling gas may be supplied by way of a regulating valve. The current source **10** of preferably 500 to 7000 volt tension has its negative pole connected with the cathode **3** by way of a regulating resistance **11**, the positive pole being connected with the wall of the vessel. The dash line represents the limit of the negative glow, whilst for example the body **14** to be treated rests on an insulating frame **13**.

BERNHARD BERGHAUS.
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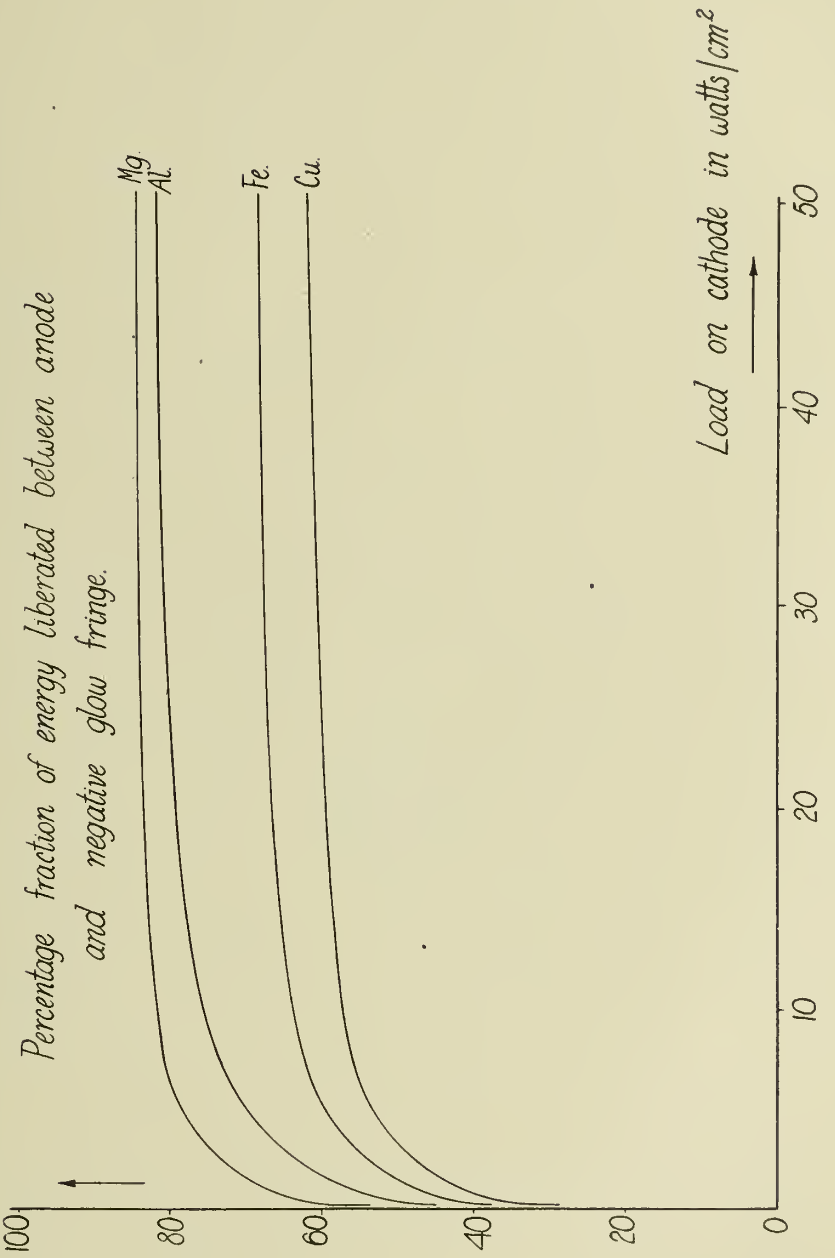

Fig.1

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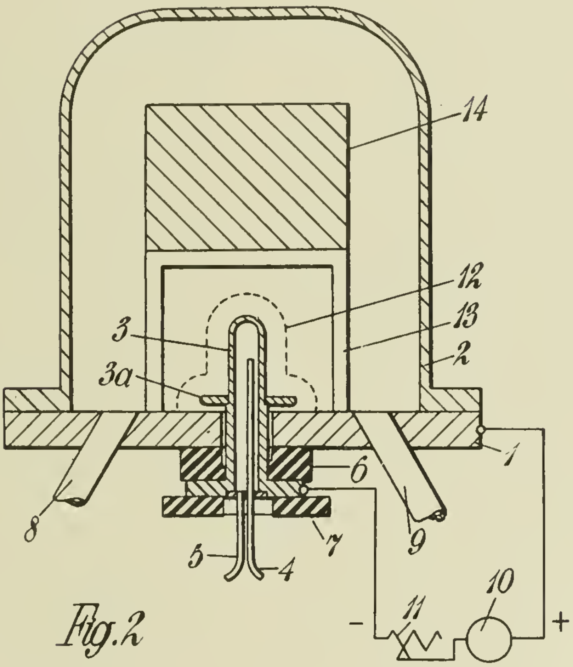

Fig. 2

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ALIEN PROPERTY CUSTODIAN

ELECTRICALLY HEATED VACUUM ANNEALING AND FUSION FURNACE FOR METALLIC AND NON-METALLIC MATERIAL

Bernhard Berghaus, Berlin-Lankwitz, and Wilhelm Burkhardt, Berlin-Grunewald, Germany; vested in the Alien Property Custodian

Application filed September 28, 1938

An apparatus is already known for producing high temperatures by means of cathode rays directed and united on to a small space, in which the cathode has for example the form of a hollow ball or a concave mirror. The cathode rays proceed outwardly from this hollow ball and are concentrated on the article to be heated, which may be neutral or connected up as anode. The wall of the known apparatus consists of glass. This known apparatus has it is true been used for scientific experiments, but it has not gained introduction into the arts, which is to be attributed to the liability to breakage on the part of the glass apparatus and the difficulties relating to the high vacuum necessary for producing cathode rays and the requisite high voltage of 20 to 300,000 volts.

An electric oven or furnace for heating articles to be introduced therein is also known in which the heat evolution of the negative glow, preferably in an attenuated gas atmosphere, more particularly an atmosphere of inert gases or other gases of low electro-negative character or a mixture of such gases, is used for the heating in such a way that the article to be heated either itself forms the negative electrode or is surrounded by it or is in good thermally conducting connection with it. In this connection it is known for the casing of the oven itself to serve as electrode, and in fact it may be connected up in circuit as anode and cooled. However, the casing of the known oven or furnace may also be connected up as cathode and the anode pass axially through the furnace in the form of a wire. This furnace also has not up to now gained introduction on a technical scale since it is not capable of handling the substantial electric outputs necessary in the technics, and the discharge, particularly at the insulators, readily strikes over into an undesirable arcing with the result that the gas discharge is upset and the heating has to be interrupted. These disadvantages are all removed by the present invention.

The present invention relates to an electrically heated vacuum annealing and fusion furnace or oven for metallic and non-metallic material which is distinguished by the fact that the wall of the oven or furnace is connected up wholly or partly as a cathode with respect to an insulated introduced anode. The material to be heated is arranged in the furnace electrically and thermally insulated. It rests either on an insulating plate or in a crucible of quartz, glass, porcelain or other ceramic masses or on a plate or in a crucible of metal or graphite, which is carried by a coolable lead-through arrangement. Preferably the wall of the furnace connected up as cathode consists of metal, preferably of iron or steel or still better of light metal or a light metal alloy. The oven wall connected up as cathode is in the case of short-period annealings or fusions constructed so as to be coolable. The oven wall connected up as cathode may however also be surrounded with a heat-insulating material, particularly for lengthy annealings. The oven wall connected up as cathode may consist of an electric semi-conductor, such as graphite or slate. The material to be annealed or fused may be in conducting connection with the anode or may itself form the anode. The pressure in the oven or furnace chamber preferably amounts to 10 to 0.05 mm., the voltage on the furnace chamber amounting to about 500 up to 7000 volts. The current cover per square centimetre of surface of the cathodically connected furnace wall preferably amounts to 0.5 to 100 mA. It may assume still higher values, however, if for example for sintering or fusing purposes temperatures are necessary up to 3000° C. and more. The insulated introduced lead-through element may be metallic and at the same time may be the current lead in for the anode, or, if the anode has a separate current lead, may consist wholly of insulating material, e. g. glass, quartz, ceramic masses, the insulated lead-through element likewise advantageously being cooled at its interior wall. The current lead in for the anode and the insulated introduced supports for the article or articles may advantageously be disposed concentrically. For the plate or the bed of the furnace or oven, upon which the articles rest, several supports, as described, may be passed in through the furnace wall.

For operating the furnace advantageously a direct voltage is used, the negative pole being on the housing and the positive pole on a separate, insulated, screened and cooled introduced anode; however, alternating voltage is also suitable if the effective surface of the introduced electrode is made very small with respect to the surface of the furnace housing, when a rectifying effect is produced. The current lead in for the anode is surrounded at a small distance by the cathode. The space advantageously forms a ring gap and protects the insulating material arranged behind the same from the impact of charge carriers from the gas discharge, as well as from particles disintegrated off the cathode, and the heat radiation. The insulating material which is behind the ring gap partly represents a prolongation of

the same. The distance of the metallic jacketing of the current lead in for the anode into the gas space is to be chosen smaller than the distance of the glow fringe around the cathode. In practical operation a distance of 5 to 0.1 mm. has proved to be sufficient. It is essentially dependent upon the gas pressure and the voltage applied between the electrodes. It is advantageous to construct the gap in labyrinth form in order to prevent direct access of charge carriers from the discharge and disintegrated particles. In order to apply still higher voltages than 7000 volts the ring gap may be partly provided with an insulator, e. g. with quartz, glass, porcelain and so forth. The current lead in is conducted hollow and is cooled at its inner wall in order to protect the insulating means from heating.

The vacuum furnace described in more detail below depends upon a completely new method of converting electrical energy into heat, and the attenuated gas in the space between the glow fringe and the anode on applying a voltage serves as a resistance heating element which surrounds the material to be heated.

Experiments have shown that the energy supplied to a gas discharge when the "heating voltage" (referred to in German as "Brennspannung") is equal to the cathode drop, is completely converted into heat at the cathode and consequently no appreciable heat is liberated in the space between the glow and the anode. If on the other hand the "heating voltage" exceeds the cathode drop, there takes place a heating of the glow fringe/anode space which increases with the difference between the two voltage values. This difference can be produced by the following expedients: It has been found that by increasing the power of the gas discharge the proportion between the "heating voltage" and cathode drop increases (see curves, Figure 1). It has further been found, as is apparent from mutual comparison of the curves in Figure 1, that the ratio of the "heating voltage" to the cathode drop is the more favourable the more readily the cathode material emits. Further experiments have shown in confirmation that for example still better values are produced by light metals oxidised right from the start or light metals spontaneously oxidising during the operation. It has also been found that the form of the gas space between the glow fringe and anode is important for the ratio of "heating voltage" and cathode drop, and in fact the ratio of the "heating voltage" to cathode drop increases the greater the fraction of the space between glow fringe and anode, which is occupied by the article. If for example an article of metallic or non-metallic nature is introduced into this gas space then, corresponding to its size, the same assumes in certain time a maximum temperature which depends upon the energy applied. If the quantity of heat liberated at the cathode is not accumulated, but is continuously led away by means of cooling water, then for the heating of iron bodies of various sizes an economy for the furnace is obtained which increases with the size of the iron bodies.

Finally it has also been established that the degree of vacuum and the nature of the gas used have an influence on the ratio of "heating voltage" to cathode drop.

In a furnace of 6 litres capacity iron articles of various sizes were introduced and heated to a temperature of for example 1000°. With copper as cathode material and hydrogen as filling gas, at a pressure of 0.2 mm. of mercury an efficiency was obtained, in spite of the unfavourably chosen conditions, of 10% for 0.5 kg., 30% for 5.5 kg., and 40% for 11.5 kg.

The principle of the furnace or oven obviously depends upon the fact that the otherwise usual electric heating element in the form of wire spirals, silicon carbide rods or other materials is replaced by the attenuated gas. What has proved to be surprising in these experiments is that on the one hand the energy distribution between cathode and gas space increases with increasing watt load referred to the cathode surface, and that special cathode materials, which favour this distribution, have been ascertained; whilst on the other hand, that the ratio of cathode drop to "heating voltage" is always greater the more space the body to be heated or the furnace charge takes up in the furnace, the more therefore the interior resistance of the remaining gas space increases, whereby in the gas space between the glow fringe and opposite electrode by purely ohmic consideration consequently more of the input energy remains for the heating of the charge.

In an experimental oven or furnace having a chamber of 6 litres the following values were for example ascertained as regards the interior resistance:

Kg	i	U_b	W_i
			Ohms
0.5	2.66	1250	470
5.5	2.00	1650	820
12.0	1.5	3200	1270

The decrease in the cathode drop in spite of the increasing "heating voltage" is clearly apparent from the fall of the current strength.

As the ratio of anomalous current to normal current on the cathode, values were obtained in the experiments up to 2000-fold. When the furnace casing formed the cathode, then with a ratio of 160-fold a 12 kg. body of iron could already in one hour be heated to 1000° at a total energy of 7 kilowatts. However, heating to medium temperatures, for example 300 to 500°, could be obtained with far smaller values, e. g. 30 to 80 times the normal current. The ratio of anomalous current to normal current consequently depends upon the temperature of the articles to be heated or on the time in which a definite temperature is to be attained.

Since a temperature of 1300° or more can conveniently be attained, tempering, letting down, clean annealing, hardening or the like can be carried out in the oven or furnace in a protective gas atmosphere. The oven therefore offers the advantage that there is no oxidation or scaling of the surfaces of the work, which is a matter of importance, especially for molybdenum steels.

The oven or furnace also offers particular advantages for the fusion of readily oxidisable and highly melting metals, since it avoids oxidation by using an indifferent gas on the one hand, and on the other hand at the said subatmospheric pressures of about 1 mm. and less an extensive degassing of the melt is brought about.

In the accompanying drawing the invention is shown schematically in some detail in one constructional example, Figure 2 showing a section through an electrically heated vacuum annealing and melting oven or furnace for metallic and non-metallic material, in which the wall of the oven is connected up as cathode of a glow discharge with respect to an insulated introduced

anode, and in which the material to be annealed is arranged electrically insulated in the oven, and in which the electrically heated gas between the cathodic glow fringe and the anode forms the heating element for the material to be heated. The vacuum annealing and melting oven consists of a lower part 1 and a removable upper part 2, which are connected together in vacuum-tight fashion by means of seals 3 and 4, and which individually or jointly form the cathode. The upper part 2, constructed for example in the form of a hood, is provided with a cooling jacket 5 to which a cooling medium may be supplied through the lead 6, which medium can be led off through the outlet 7. In the upper part an opening is also provided which is closed off by means of a viewing window 8. The insulated pipe connection 9 arranged in the lower part has connected to it a vacuum pump (which is not shown) by means of which preferably a pressure of 10.0 to 0.05 mm. of mercury can be adjusted The lower part 1 also possesses a pipe connection 10, likewise insulated with respect to the cathode. The parts 11 and 12 are insulating rings and the parts 13 and 14 are insulating and pressing-on rings. A pressure indicating appliance may be attached to the pipe connection 10, and through this connection 10 there may also be supplied a filling gas in regulated quantity by way of a regulating valve, which is not shown. According to the material being heated or annealed, as filling gas may be used an inert gas, such as argon, krypton, xenon, helium, or a reducing gas, such as hydrogen, hydrocarbons or the like. Nitrogen, ammonia or similar gases may also be employed if an action is intended on the for example metallic material being heated or annealed. Gases or vapours may also be supplied which bring about chemical actions on the material being heated. In the lower part 1 the anode 15 is also arranged, insulated and screened off, as well as the lead-through element 16 which is made hollow and to which a cooling agent may be supplied through the lead 17, and led off through the lead 18. Between the anode 15 and the lower part 1 of the vessel there is a narrow gap of labyrinth form which is so narrow that no glow discharge is possible in the gap. Also between the anode 15 and the lead-through element 16 there is a similar narrow gap of labyrinth form. By means of an insulated screening pin 19, the lead-through element 16 carries for example a quartz plate 20 on which the material 21 to be heated is disposed in an insulated manner. In place of the quartz plate 20, a fusion crucible for example of carbon or of ceramic material, such as beryllium oxide, or even of metal may also be provided for accommodating the material to be heated or fused. 22 and 23 are insulating rings and 24 is an insulating and pressing-on ring, which is pressed on by means of a screw arrangement not shown. 25 is a cooling duct to which a cooling agent can be supplied.

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Serial No. 232,237
2 Sheets-Sheet 1

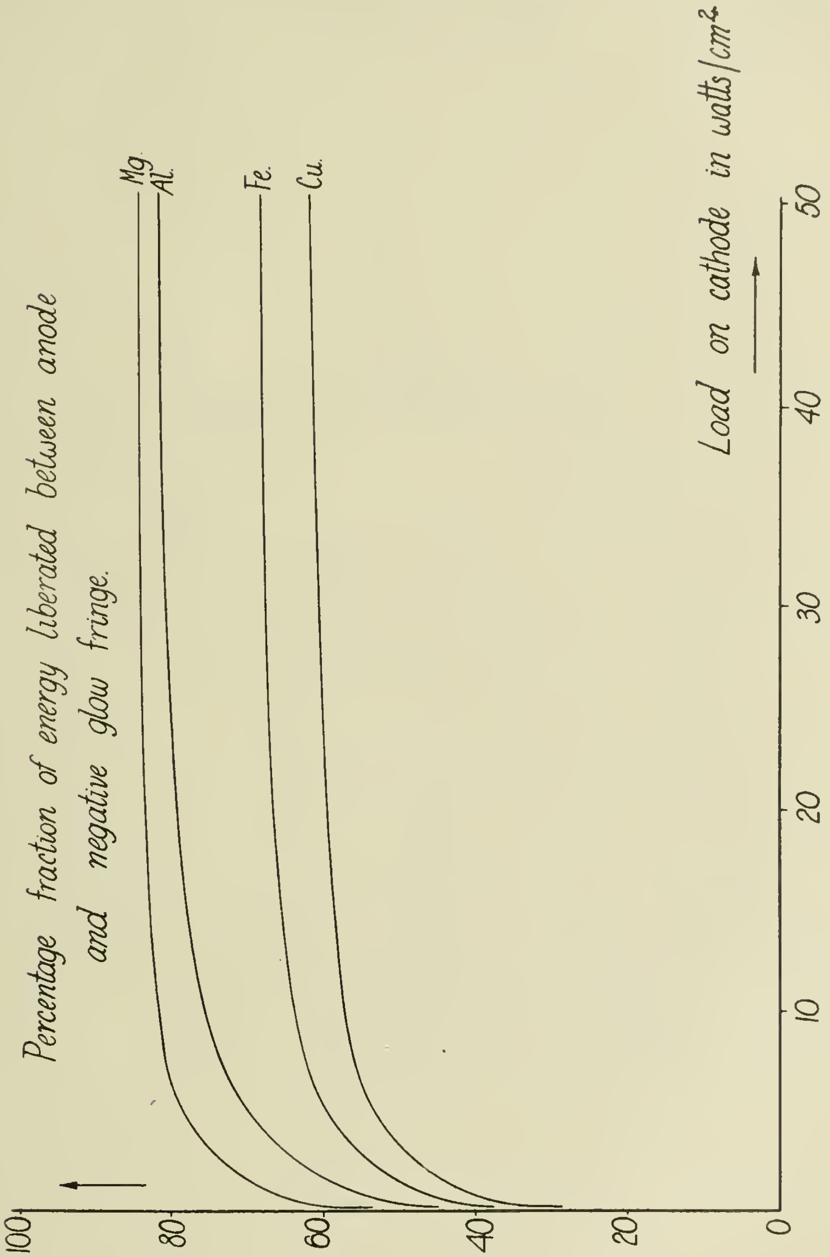

Fig.1

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PUBLISHED

MAY 25, 1943.

BY A. P. C.

B. BERGHAUS ET AL

ELECTRICALLY HEATED VACUUM ANNEALING AND FUSION FURNACE FOR METALLIC AND NON-METALLIC MATERIAL

Filed Sept. 28, 1938

Serial No. 232,237

2 Sheets-Sheet 2

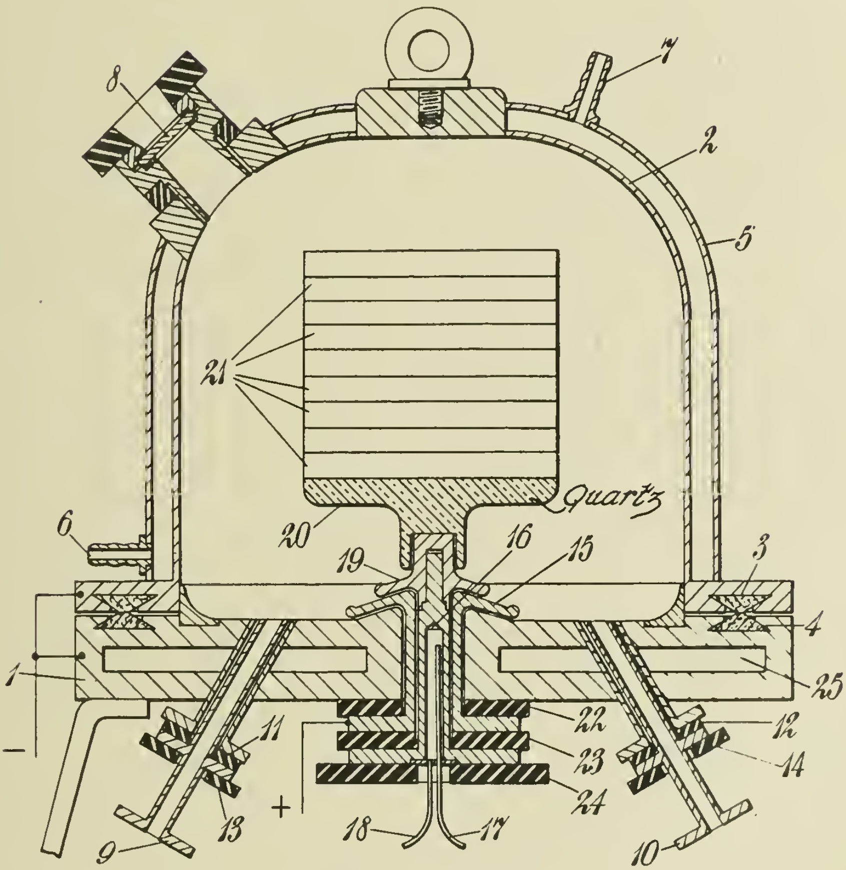

Fig. 2

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Published May 25, 1943 Serial No. 234,006

ALIEN PROPERTY CUSTODIAN

CALCULATING TYPEWRITERS

Hugo Schüler, and Hans Grüttner, Chemnitz, and Erich Dronigke, Sommerda, Germany; vested in the Alien Property Custodian

Application filed October 8, 1938

This invention relates to calculating typewriters having longitudinally movable totalizers (vertical totalizers) arranged on the paper carriage and transverse totalizers arranged on a slide.

The object of the invention is to provide a mechanism which, directly after the conclusion of a calculating operation, that is, after the operation in the last ordinal place, will make possible the locking of the calculating mechanism in simple, reliable, and advantageous manner, so that in particular, unintentional introduction of any digits into a longitudinal or transverse totalizer during the return of the transverse totalizer out of calculating position, will be prevented.

According to the present invention this is achieved by providing mechanism which the longitudinal totalizer occupying the calculating position, renders calculating mechanism locking means operative through the agency of transmission devices actuated by the transverse totalizer slide, while the rendering operative of the said locking means is effected by members actuated by means on the longitudinal movable totalizers.

An example of this mechanism embodying the invention is shown in the drawing, which illustrates diagrammatically the pertinent portions of a calculating typewriter,

Fig. 1 showing the parts in writing position before the transverse accumulator has been engaged, and

Fig. 2 the parts in calculating position with the transverse accumulator engaged, wherein both figures are shown as side views.

The machine frame **1** has guides **2** on which a slide **3** can slide horizontally. The slide **3** is drawn to the right by means of a spring **4** and serves to carry a transverse totalizer **5**. The slide **3** has an arm **6** carrying at the left-hand end a pivot pin **7** on which is mounted a spear **8** and the tongue **9**. Tension springs **10** and **11** are provided between the spear **8** and the tongue **9** and the arm **6**. The spear **8** has a lug **12** and the tongue **9** has a hump or projection **9''**, these parts constituting in known manner a tongs device for holding a projection **13** (**13'** or **13''**) on the longitudinal totalizers **15'**, **15''** which are mounted on the paper carriage **14**, the hump **9''** preventing the slide **3** from being forced away from the longitudinal totalizer.

A pivot pin **16** on the machine frame carries a lever **17** to which is jointed a bar **18** attached to a plate spring **19**; the bar **18** and spring **19** extending into a socket **20** mounted on the slide **3**, in such a manner as to form a frictional connection between this slide and the lever **17**. The lever **17** is connected by means of a rod **21** with one arm of a bell crank lever **23** pivoted on a pin **22**, the other arm of which bell crank carries a member **24** serving to lock the operating shaft **25** of the calculating mechanism **26** of the machine, as soon as said member **24** lies in front of a cam member **27** on this shaft.

A pivot pin **28** on the machine frame **1** supports a release rocker **29** which rocker cooperates with the hump or projection **9'**, on the tongue **9** and also with the horizontal arm of the bell crank lever **23**.

In operation of the machine the paper carriage **14** moves step-wise to the left. This causes the tongue **9** to be depressed as soon as the projection **13'** of the longitudinal totalizer **15'** moves over the hump **9''**. Upon passing the hump **9''** the projection **13'** encounters the upwardly directed lug **12** of the spear **8** and carries the latter along, whereby the slide **3** is also moved to the left. This results in the lever **17** being rotated counter-clockwise because of the frictional connection resulting from the spring **19** and bar **18** engaging the socket **20** on the slide **3**. The movement continues until a stop **21'** on the rod **21** encounters the machine frame **1**. From this point the socket **20** of the slide **3** moves relatively to the bar **18** and spring **19**.

Movement of the lever **17** effects turning of the bell crank lever **23** whereby the locking member **24** is raised and the drive shaft **25** released; the calculating mechanism **26** can therefore operate and digits can be introduced into the longitudinal totalizer **15** occupying the calculating position, and the transverse totalizer **5**.

When the engaged longitudinal totalizer has passed through the calculating position to its last ordinal place, the next step of the carriage **14** causes the spear **8** to be depressed in known manner by means not shown, whereby the lug **12** is disengaged from the projection **13'** of the longitudinal totalizer. The slide **3** is then impelled to the right under the action of the spring **4**. The bar **18** and the spring **19** are held due to friction in the socket **20**, so that they participate in the movement of the slide **3** causing the lever **17** to turn back whereby also the bell crank lever **23** is restored to its previous position and the locking means **24** attached thereto is again brought in front of the cam **27**, thus locking the drive shaft **25**. The printing of any digits is therefore at once rendered impossible. As soon as the lever **17** has completed its return movement and bears against the frame **1**, the friction

between the socket 20 and the bar 18 and spring 19 is overcome and these two parts are inserted into the socket.

If the carriage 14 carries a second longitudinal totalizer 15'' with a very small number of ordinal places, arranged directly behind the totalizer 15', then the lug 12 on the spear 8 is again caught by the projection 13'' of the totalizer 15'', before the slide 3 has completed its return movement. As a result the bar 18 and the spring 19 will be inserted into the socket 20 by only a small amount, and there is a possibility that the frictional connection will be imperfect, whereby the lever 17 might not immediately be operated by the slide 3 in its next advancing movement. The tongue 9, however, is slightly depressed during the movement of the paper carriage 14 to the left, at each passage of a totalizer finger 13', 13'' over the hump 9''; this takes place every time before drive of the spear 8 by the projection 13 begins. If in these conditions the slide 3 should lie in its extreme right-hand position, Fig. 1, then the lower hump 9' of the tongue 9 will lie above the downwardly offset middle portion of the release rocker 29 and will exert no action on this rocker. If, however, the slide 3 has not arrived in its right-hand end position, then the hump 9' lies above the higher left-hand portion of the release rocker 29 (Fig. 2); the said hump therefore rocks the rocker 29 in counter-clockwise direction about the pin 28, as soon as it is depressed, and the right-hand arm of the release rocker 29 engages below the horizontal arm of the bar crank 23 and turns the latter in clockwise direction whereby the drive shaft 25 is locked by the member 24 in the same manner as when the bell crank 23 is actuated by the lever 17.

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Fig. 1

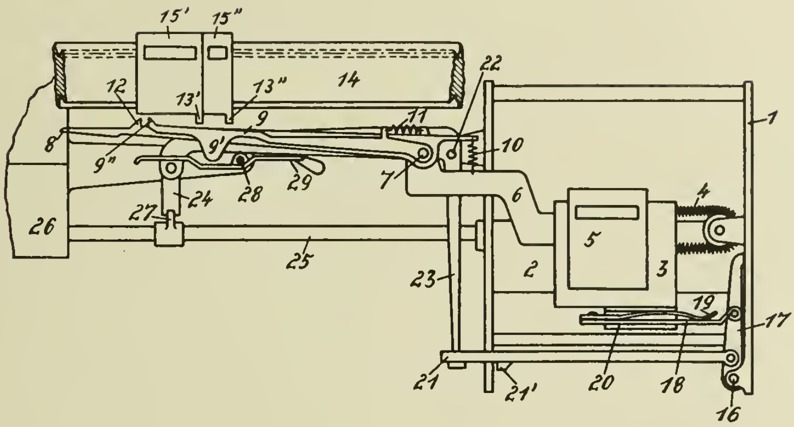
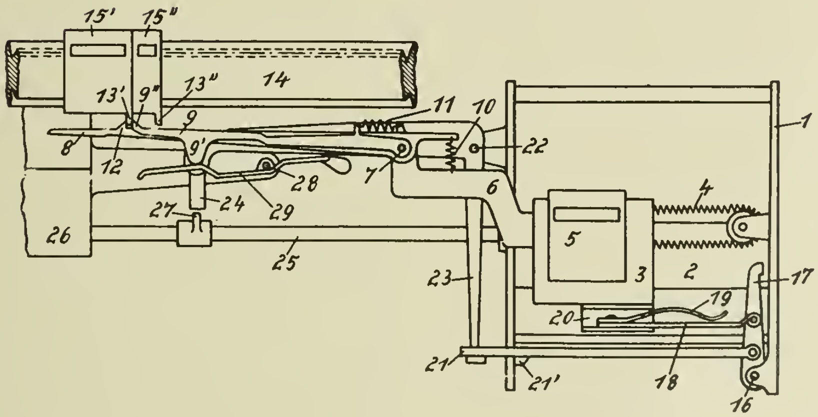


Fig. 2



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ALIEN PROPERTY CUSTODIAN

BOUNDARY LAYER CONTROL IN AEROFOILS

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Application filed October 18, 1938

My invention relates to aircraft and more particularly to aerofoils and it is one of the objects of my invention to provide novel means for compensating the losses of energy in the boundary layer of aerofoils. It is known to those skilled in the art that the lift-coefficient of an aerofoil increases in proportion to the angle of attack of the relative wind up to a certain critical angle which has been found by tests to lie between 10 and 20 degrees. The lift-coefficient developed at the critical angle of attack is called the maximum lift-coefficient. Beyond this critical angle the lift-coefficient drops again owing to discontinuity of the airflow over the upper surface of the wing. This discontinuity is known as burbling and the aerofoil is said to be in stalling position. Stalling is due to energy losses in the boundary layer of the upper surface of the wing which results in a decrease of velocity of the airflow over the wing in the direction towards the trailing edge thereof. An increase of the angle of attack results in increasing energy losses in the boundary until the velocity of the airflow at the trailing edge of the wing becomes zero and there begins backflow from the trailing to the leading edge, causing separation of the airstream from the upper surface of the aerofoil. Now stalling begins and an increase of the angle of attack will cause the separation to become more and more accentuated until the critical angle of attack is reached and separation takes place almost throughout the aerofoil from the trailing to the leading edge.

It is also known to increase the maximum lift-coefficient of an aerofoil by arranging a narrow-chord aerofoil in close relation to the trailing edge of the main aerofoil, only a narrow gap being left between the two aerofoils. This narrow-chord aerofoil is called external aerofoil section flap.

The maximum lift-coefficient can be increased by deflecting the trailing edge of the flap with a point well forward of and below the chord thereof as hinge-point. The suction which arises at the upper surface and in particular at the leading edge of the flap when deflected, sucks away the boundary layer of the main wing, thereby accelerating the boundary layer and compensating energy losses in this boundary layer. The suction effect is increased in proportion as the flap is deflected, while a linear increase of the lift occurs in proportion as the deflection angle grows until the critical angle of the flap relative to the direction of the airflow behind the main wing is reached, which according to tests lies between 30 and 35 degress relative to the chord of the main wing. Deflecting the flap to a greater angle does not increase the lift-coefficient, which then drops rapidly. This is due to stalling of the aerofoil section flap which takes place in the same way as described with reference to the plain wing. When stalled the flap is no longer effective and does not exert its beneficial action on the flow over the main wing.

Several means are known for compensating the energy losses in the boundary layer of a simple aerofoil and for thereby delaying stalling to a much higher angle of attack. They are known as means for boundary layer control, the most effective of which are the following:

1. Removal of the boundary layer of the aerofoil at the rear half of the upper surface through a spanwise extending slit or series of openings by means of suction maintained at the inside of the wing, for instance with the aid of a blower or other pump provided in the interior of the wing. It has been found by tests that the maximum lift-coefficient of a certain aerofoil, which without boundary layer control amounted to 1.5, can be increased in this manner to 5.5. By the same means the profile drag coefficient of the wing is substantially reduced. Thus the ratio of lift to drag of the aerofoil which is a measure of its efficiency, is increased considerably.

This mode of boundary layer control however involves several disadvantages which render it practically inapplicable: a great quantity of air must be sucked off and handled which requires a large and heavy pumping installation, air ducts etc. The operation of the pump requires considerable power and the difference between the angle of attack for cruising and the maximum lift-coefficient is very great (about 40 degrees) which requires a long-legged and heavy undercarriage, to say nothing of the discomfort for the passengers and crew of an airplane equipped with this kind of boundary layer control.

2. Boundary layer control by blowing air tangentially to the upper surface of the aerofoil through a slot opening towards the rear. This method is not as satisfactory as the one first mentioned and with a very high power absorption the maximum lift-coefficient still remains below 3. Thus this method offers the same advantages but also involves the same drawbacks as the method first mentioned.

3. The energy losses in the boundary layer of an aerofoil can also be compensated by subdi-

viding it by spanwise extending slots into two or more parts, each of well rounded form, forming a so called Lachmann or Handley-Page. With any such combination of parts a lift-coefficient of about 2,3 can be obtained.

These slotted wings involve the drawback that the maximum lift-coefficient, which is only a moderate one, is only reached at a very high angle of attack, the cruising and maximum lift angle being spaced about 30 degrees; and moreover the profile drag is considerably increased.

According to the present invention, now, boundary layer control is applied not to the main wing, but to the external aerofoil section flap of an aerofoil provided with such flap.

By applying the boundary layer control to the flap, stalling of the flap does not take place at the low deflection angle of about 35 degrees, but is delayed to a much higher deflection angle and the lift-coefficient of the flap-wing combination can thus be increased to about 4.

Windtunnel tests have shown that the volume of air to be sucked off and the power required for this purpose are proportional to the surface of the wing to which boundary layer control by suction or pressure is applied. In the case of the combination of a main wing and an external aerofoil flap of equal span they are proportional to the chord.

As in most cases the chord of the external aerofoil flap is only one sixth of the total chord of the combination, the power required to obtain very high lift-coefficients of the combination and the volume of air to be sucked off are also about one sixth of those required to obtain the same results on a plain wing by means of boundary layer control by suction or pressure.

Another important advantage offered by the invention consists therein that the high lift-coefficients are reached at normal angles of attack, viz. 10 to 15 degrees.

The application of boundary layer control to a wing subdivided by spanwise extending slots can also be applied to the external aerofoil flap. In that case the following advantages are obtained:

1. In the case of its application to the external aerofoil flap the increase of the profile drag coefficient connected with the subdivision of the aerofoil covers only a minor part of the total wing area and consequently also the total increase of profile drag is only a fraction of that obtained by subdividing a plain wing by slots.

2. The highest lift-coefficient is reached at a normal angle of attack of from 10 to 15 degrees.

In the drawings affixed to this specification and forming part thereof several embodiments of my invention are illustrated diagrammatically by way of example.

In the drawings

Fig. 1 is a front elevation of a twin-engined mid-wing monoplane having tapered wings, while

Fig. 2 is a diagrammatic view, drawn to a larger scale and showing the wing structure and its relation to the fuselage.

Figs. 3 to 6 are cross-sections of combinations of a wing with an external aerofoil section flap, in which various boundary layer control systems are applied to the flap.

In Figs. 1 and 2 the invention is shown as embodied in a mid-tapered-wing monoplane in which I is the fuselage and II are the opposed wings, the method of boundary layer control being removal of the boundary layer by suction. Fig. 2 shows the external aerofoil section flap **1** as being hollow and hinged to the points **3** and being formed with a spanwise extending slit **2**. Hollow streamlined supporting members **4**, **4a** distributed along the span allow the air entering through the slit **2** into the flap to pass into the hollow rear portion **5** of the main wing II and through a tube **6** to the pump or fan **7** which provides for the required suction and is driven by the engine **8** or an auxiliary unit over a suitable clutch operated automatically or by the pilot or both. A spanwise extending channel **9** leads the air from the pump **7** to the outside. End-plates **18** reduce pressure losses at the outer ends of the external aerofoil flap.

The operation of this boundary layer control is as follows: the air forming the boundary layer of the flap is sucked off through the slit **2**, the hollow flap **1**, the supporting members **4**, **4a**, the rear part **5** of the wing II and the tube **6** into the pump **7** which ejects it through the tube **9**.

Deflection of the flap is carried out as follows: a jack **14** acts on a lever **17** which rotates the torsion tube **10** in clockwise direction, its motion being transmitted through a lever **11** to a rod **12** hinged to the leading edge of the flap at a point **13** so arranged above the hinge points **3** of a flap as to make the operating force a minimum. The flap is thus rocked in clockwise direction and its angle relative to the chord of the main wing is increased. At the same time the aileron **20** is deflected to the same or a somewhat smaller angle than the maximum deflection angle of the flap, which is governed by a suitable device linked between the torque tube **10**, the lever **17** and the ailerons **20** which also enables the ailerons to be raised and lowered as required for the rolling motion of the airplane.

While in the embodiment shown in Figs. 1 and 2 the boundary layer is sucked off from the main aerofoil through a slit extending spanwise of the external section flap, Fig. 3 illustrates the ejection of an air jet through a similar slit **21** extending spanwise over the front half of the hollow flap **22**, the air being forced by a fan or the like (not shown) mounted in the hollow main wing **23** through the hollow supporting members **24**. The interior of the flap is shown to be subdivided by a spanwise extending partition **25**.

In the modification illustrated in Fig. 4 the external section flap **26** is provided with an auxiliary wing **27** arranged in front of its leading edge which may be utilized for the sucking or blowing off of the boundary layer on the flap in the manner indicated in Fig. 1 or 3.

Fig. 5 illustrates a combination of an aerofoil **28** with an external section flap **29** divided in two halves by a slot **30**, and Fig. 6 shows a flap **31** divided into three parts by two slots **32**, **33** adapted to serve as air passages for the boundary layer sucked or blown off the flap surface and carrying along the boundary layer on the main wing.

Various changes may be made in the details disclosed in the foregoing specification without departing from the invention or sacrificing the advantages thereof.

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PUBLISHED MAY 25, 1943. BY A. P. C.

H. K. D. VAN DEN BUSSCHE

BOUNDARY LAYER CONTROL IN AEROFOILS

Filed Oct. 18, 1938

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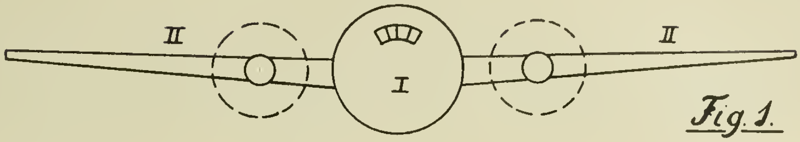

Fig. 1.

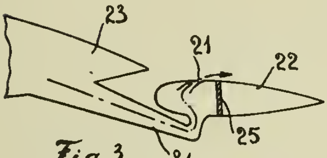

Fig. 3.

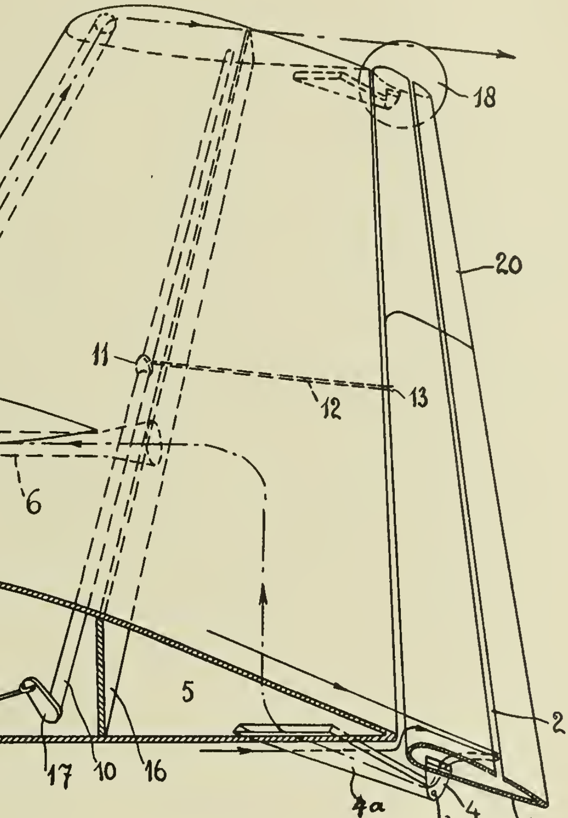

Fig. 2.

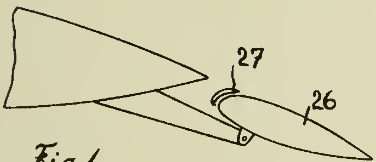

Fig. 4.

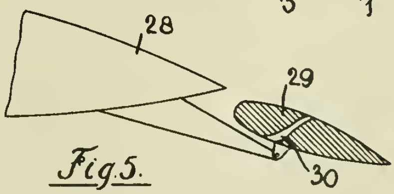

Fig. 5.

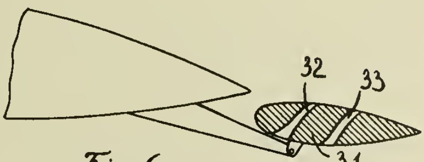

Fig. 6.

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ALIEN PROPERTY CUSTODIAN

SHEET METAL BODY

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Application filed October 24, 1938

This invention relates to a sheet metal body and particularly to such a body for vehicles.

An object of this invention is to form a body of sheet metal in such a manner that it can be painted entirely by dipping.

Another object of this invention is to form a welded body in which the welds are not visible from either the exterior or interior of the vehicle.

A further object of this invention is the provision of a sheet metal body in which the body parts are interconnected by seams running longitudinally or downwardly of the vehicle.

A still further object of this invention is the provision of a sheet metal vehicle body in which the body parts are interconnected by seams running to a free edge of the body or terminating in a place to be covered by supplemental parts.

A specific object of this invention is the production of a vehicle body from welded sheet metal parts, which, when assembled, presents a smooth exterior and interior requiring no supplemental grinding or smoothing, and which may be painted in final form by a dipping process.

Other objects and advantages of my invention will be apparent from the single form hereinafter described taken in connection with the attached drawings wherein:

Fig. 1 is a side view of a completely assembled body formed in accordance with this invention;

Fig. 2 is a cross sectional view along the line II—II of Fig. 1;

Fig. 3 is a cross sectional view along the line III—III of Fig. 1;

Fig. 4 is a cross-sectional view along the line IV—IV of Fig. 1, and

Fig. 5 is a cross-sectional view along the line V—V of Fig. 1.

In the preferred form of this invention, as illustrated in the accompanying drawings, the reference numeral 1 indicates the body apron containing the front wheel insert or opening 2. The front cover or hood is indicated at 3. The body has a sheet metal roof 4 which continues to form the windshield frame 5. The body structure also includes the windshield post 6, the roof rail 7 which is a continuation of the side walls 8 in which in turn are integrally formed the rear wheel inserts or openings 9. A rear deck or cover 10 completes the main body structure.

The interconnection between the apron 1 and the windshield post 6 is illustrated in Fig. 2 which is a cross-sectional view along the line II—II of Fig. 1. The apron 1 and the windshield post 6 being made of sheet metal are bent at their edges to to form a fold 12, the edge of the windshield post being bent around the edge of the apron as indicated. To insure against slipping of the fold, the edges may be welded together, preferably at a point lying at the wheel insert 2. Accordingly when the mud guards or fenders are later added, this welding point will be hidden from view and, therefore, need not be ground or finished. The apron is preferably formed with an interior strengthening leaf 11 which is also interconnected with the windshield post 6 through a fold 13, formed similarly to the fold 12. This fold may also be welded, if desired, to prevent slipping.

In Fig. 3 which is a cross-sectional view along the line III—III of Fig. 1, the connection between the upper apron which is an integral extension of the windshield frame 5, and the apron proper 1 is illustrated. This connection is preferably made by bending the edges of the upper apron 14 and the main apron 1 in the shape of contacting flange forming between them a hollow space 15. The parts are rigidly held together as for example by spot welding within the space 15. Since this space will be formed within the interior lower portion of the vehicle, it will not be usually seen and, therefore, need not be finished by grinding or smoothing.

The interconnection between the sheet metal roof 4 and the roof rail 7 is indicated in Fig. 4, this view being a cross sectional view along line IV—IV of Fig. 1. Such interconnection is preferably brought about by folding the edge of the roof about an outwardly and upwardly extended portion of the roof rail. The resulting channel not only forms a firm connection between these parts, but also acts as a gutter to carry away rain. The folded edges may be welded together as by spot welding, and if such welding is done within the channel the welding spurs will remain unseen and will not have to be removed.

Fig. 5 is a cross-sectional view along the line V—V of Fig. 1 and illustrates certain preferred details of my novel roof construction. It is of advantage that the roof be stiffened against bending and to that end I propose to employ a transverse wall 17. The lower or outer edge of the transverse wall 17 may be interconnected with the said wall 8 by extending it into the fold 16. The wheel insert 9 comes together with the lower side 18 of the lining sheet 19 and is welded to the said wall 8 by spot welding. Accordingly, when the vehicle is completed by the addition of the mud guard or fender 20, the resulting

welding seam at this point is entirely hidden. The lining sheet 19 is so formed that an intermediate leather member may be pinched beneath its edge 21 under pressure. The inner edge of the transverse wall 17 is interconnected with the frame of the rear window 22. This connection may be brought about by spot welding, the spots being covered by the inserted window stripping (not shown).

As will be seen from a study of the above described construction, all of the folds, seams, or channels interconnecting the various parts will be unseen or will extend longitudinally of the vehicle and downwardly to a free edge thereon or to a portion which is to be covered by supplemental parts. The fold connecting the roof 4 with the said wall 8 and the roof beam 7 extends rearwardly and downwardly along the edge of the side wall 8 and into the wheel insert 9, so that its end is covered by the mud guard 20. The fold 16 running forwardly merges into the fold 12 through which the wind shield post is first connected with the roof 4 then with its wind shield frame 7 and finally with the apron 1. This fold will run under the forward wheel insert 2 which will be covered by the addition of a front mud guard (not shown). By means of the merging folds 12 and 16 there will be no cross seams but a T shaped connection as indicated at the line C—C of Fig. 1. This seam can be readily welded and necessitates only a slight finishing operation since it is later covered by the door.

In addition to the folds 12 and 16 other seams occurring are also positioned to extend to covered portions or to a free edge of the vehicle. The formed edge 23 between the front hood and the apron 1 will extend into the front wheel insert 2. The formed edge 24 will extend into and be covered by the rear deck 10. The seam 25 extending between the front and rear wheel inserts is connected with the under edge of the body 27 by means of the downwardly extending seam 26.

As a result of the position and arrangement of the seams and folds of the completed body, this body may be painted both for its undercoat and its final coat merely by a simple dipping process. Previously dipping could not be used because of the fact that the paint flowing along the body surfaces would collect in many places and mar the final finish. This necessitated a large amount of hand work to remove these lumps or gatherings of paint and then the repainting of those spots. As a result the dipping process while initially cheaper, involved so much extra labor as to eventually become more expensive than other painting methods. However, by forming the vehicle body in the manner above described wherein the paint on the body surfaces will collect and run along seams which terminate either at a lower free edge of the body or at places which will be covered by later added supplemental parts such as the body fenders, all of the later finishing by hand previously necessary can be avoided. Accordingly, the cheapness and other advantages of the dipping process for painting vehicles for the first time becomes practical.

It will be noted that if a body is formed in accordance with my invention it will be entirely covered by paint during the dipping operation with the exception of the inside of the roof. In order to permit penetration of the paint to this portion, however, the extension 18 of the lining 19 may be provided with small openings which will remain unseen and which will open up the hollow portion 28. If air pockets tend to form beneath the roof 4, these may be removed by turning the vehicle body about the axis A—A during the dipping operation.

ERWIN KOMENDA.

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MAY 25, 1943.

BY A. P. C.

E. KOMENDA

SHEET METAL BODY

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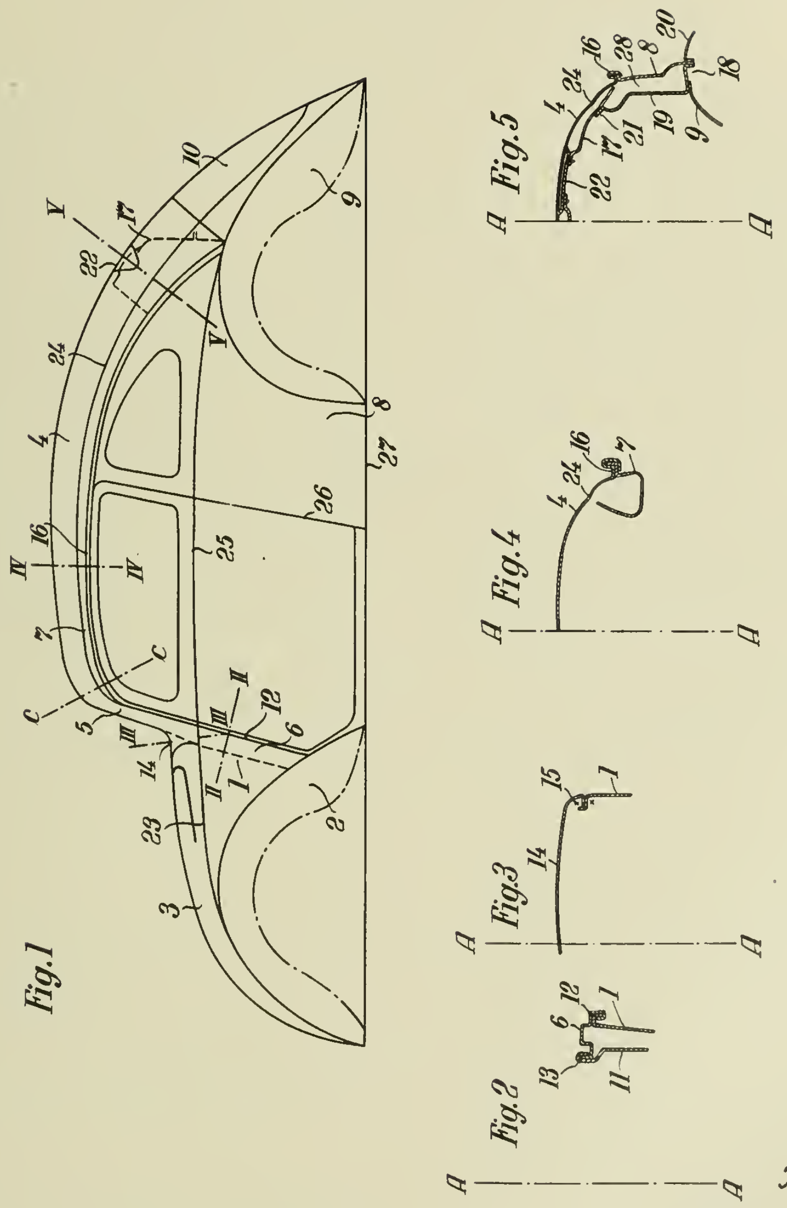

Inventor:

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by A. A. Wicke

ATTORNEYS

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ALIEN PROPERTY CUSTODIAN

AIRCRAFT MOTOR

Johannes Schmidt, Berlin-Eichkamp, Germany; vested in the Alien Property Custodian

Application filed October 20, 1938

The present invention relates to internal combustion engines and more particularly refers to an aircraft motor provided with a charging device and a device for producing the mixture of fuel and air.

In internal combustion engines of this kind known hitherto the spray nozzle for the fuel is arranged in front of or behind the charging device, that is to say, in the suction- or pressure pipe. This arrangement for instance has the advantage that the use of a single fuel pump is sufficient and, moreover, relatively small injection pressures only are required.

Apart from these advantages, the known internal combustion engines of the kind characterized above, have some disadvantages also. If the spray nozzles are so arranged as to discharge in front of the charging device, they show the drawback, that due to the vaporization of the fuel the air is strongly cooled, whereby the humidity may be separated from the air which eventually may be accompanied by formation of ice. Damages of the charging device and the motor as well as other break-downs may then be caused. For this reason, means for preheating the air had to be provided which, however, have the drawback, that by the device for preheating the weight of the internal combustion engine is considerably increased. Moreover, the provision of a device for preheating substantially reduces the output of the engine owing to a decreasment of the admission.

A further disadvantage consists in this, that at a small number of revolutions of the motor, for instance if the motor is running idle, the formation of the mixture of fuel and air is relatively bad, because, at such working orders the velocity of the air is rather small.

Moreover, there is the further drawback, that drops of fuel are thrown out by the charging device which drops are deposited at the walls of the charging pipe, whereby the composition of the mixture of fuel and air is altered in an inadmissible manner.

If the device for injecting the fuel is arranged behind the charging device, i. e. discharges behind the charging device, care is to be taken, that at small outputs also sufficiently great velocities of the air are available for producing the mixture aimed at and for distributing same. For this purpose, an additional regulatable throttle member is required which must be controlled in dependence on the output and on the altitude in which the motor is to operate. This drawback proves in particular to be rather important when using a plurality of separated charging pipes, because then a special throttle member is required for each pipe which throttle members all must be very exactly adjusted with respect to each other.

Now, it has been found, that in a very simple manner all the above described drawbacks may be obviated.

Therefore, if a charging device of the kind of a centrifugal blower is used, then to this end the fuel spray pipe is, according to the invention, so arranged, as to discharge into the spiral member of the blower.

In connection with carburettors provided with rotating blades, it is known already to feed fuel, by way of openings in the revolving shaft, into the interior of the blade rim. This known construction, however, has for instance the drawback, that the shaft of the wheel of the centrifugal blower must be provided with special means for guiding the fuel and, moreover, sealing means must be provided to prevent fuel flowing out at undesirable points.

With internal combustion engines according to the invention the spray nozzle preferably is arranged directly behind the runner or rotor wheel of the centrifugal blower. Preferably, the construction of the blower and the arrangement of the spray nozzle is so chosen, that the discharge opening of the spray pipe lies near the end of smallest cross section of the spiral member of the casing of the centrifugal blower.

This arrangement of the spray nozzle according to the invention has the advantage, that in the spiral member serving to collect the air leaving the runner as well as serving to convert the velocity-energy into pressure-energy, the air is already so strongly heated, that troubling separation of water or even formation of ice may no longer take place. At the characterized points of the spiral member the velocity of the air is relatively great and only a little smaller than that at the circumference of the runner. Also when running idle and with the number of revolutions then prevailing, the available velocity is sufficient for a satisfactory atomizing of the fuel. The effect of the whirling is still increased by the fact, that on the way to the outlet opening of the spiral member permanently fresh air is blown into the mixture of air and fuel and is mixed with the latter by whirling. Hereby a throwing out of fuel drops cannot be caused, as would probably to be feared for the points situated in the runner. By injecting fuel into the spiral member a relatively strong cooling of the

charge is effected, so that thereby the so-called pressure ratio of the charging device is increased.

Near the end of smallest cross section of the spiral member of the casing of the centrifugal blower, a device for injecting a cooling medium also may be provided. The cooling medium and the fuel may, however, be injected simultaneously. An additional regulatable throttle member is no longer required.

If a plurality of charging pipes are provided, a plurality of spiral members, each having a special nozzle, also must be provided which preferably are of same size and of same construction and are commonly supplied with fuel.

In the accompanying drawing two embodiments according to the invention are shown diagrammatically by way of example.

In this drawing

Fig. 1 shows in elevation an internal combustion engine with a charging device, the motor being arranged below the charging device, and

Fig. 2 represents a modification of the internal combustion engine with cylinders set in V-fashion.

As shown in Fig. 1, the motor with suspended cylinder block is designated with **1**. Above this block the casing **2** of the charging device is provided, the blade wheel of which is designated with **3**. The wheel **3** is rotatably mounted on the shaft **4**. Connected to the charging device **2** is the spiral pipe **5**, **6**; **5** designating the part of smallest cross section of the spiral and **6** the outlet socket. Connected to this outlet socket **6** is an elbow **7** or the like which discharges into the fuel mixture pipe of the cylinders of the motor.

Near the end of smallest cross section of the spiral member, i. e. about at the point **5**, the nozzle for injecting fuel is provided according to the invention. The pipe leading to this nozzle is designated with **8**. This pipe **8** and the nozzle are detachably connected to the wall of the spiral pipe by means of a screw connection **9**. The nozzle itself is designated with **10**. The outlet openings of the nozzle **10** discharge into the part **11** of the spiral pipe.

According to the modification shown in Fig. 2, two charging pipes are provided. The motor **12** has two rows of cylinders **13** and **14** which are obliquely arranged in a downward direction. In the casing **15** of the centrifugal blower or compressor, the bladed wheel **16** is arranged. The wheel **16** is rotatably mounted upon the shaft **17**. Connected to the casing **15** is a spirally extending pipe **18** which continues in a rectilineal pipe **19** discharging, by way of a connecting socket **20**, into the mixture pipe of the one row **14** of cylinders.

Besides the spirally extending pipe **18**, a second spirally extending pipe **21** is provided which is arranged about symmetrically to the first pipe. The pipe **21** continues in a rectilineal part **22** which is connected, by way of an intermediate member **23** to the mixture pipe of the cylinder row **13**.

The supply pipe, leading to a nozzle **26** is designated with **24**. The pipe **24** and the nozzle **26** are detachably connected to the wall of the pipe **18** by means of a screw connection **25**.

A second nozzle discharging into the spirally extending pipe **21** is designated with **29**, whereas the appertaining pipe itself is designated with **27**. Here also the pipe and nozzle are, by way of a screw connection **28**, detachably connected to the wall of the pipe into which the nozzle discharges.

According to the construction shown in Fig. 2 also the two nozzles are arranged in the range of the end of smallest cross section of the spirally extending pipes.

Besides the arrangements of the nozzles described other arrangements at the spiral member also are possible. Moreover, the outlet direction of the fuel jet may be chosen as desired.

Finally in connection with a throttle flap at any desired point of the suction- and pressure pipe, a device for idle running may be provided. Such devices are formed as means for injecting fuel and are caused to actuate if strong throttlings are effected. When using such devices for idle running preferably with a corresponding nozzle, the production of a favorable mixture is warranted. The nozzle for idle running preferably is connected to the member for regulating the motor and to the device for injecting fuel.

JOHANNES SCHMIDT.

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J. SCHMIDT

AIRCRAFT MOTOR

Filed Oct. 20, 1938

Serial No.
236,006

Fig.1

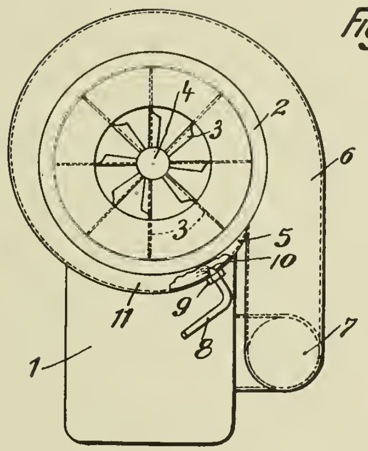
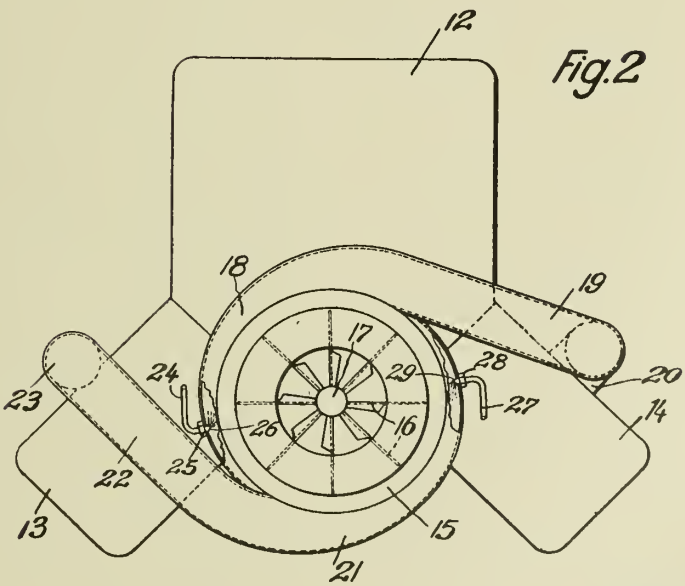


Fig.2



Inventor

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By

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ALIEN PROPERTY CUSTODIAN

SEAMLESS DRUM FOR USE IN HIGH-PRESSURE BOILERS AND THE LIKE

Maximilian von Schwarz, Freiberg/SA, Germany; vested in the Alien Property Custodian

Application filed October 31, 1938

This invention relates to a seamless drum, or drum-like cylindrical hollow body, intended for use in high-pressure boilers and the like. The characteristic features of this improved drum or body are, in the first place, that it has been obtained by the centrifugal casting method and is so contracted at its end portions that these portions form partly or completely closed drum bottoms. The end portions of the hollow body may be reinforced at their outer circumferential surface in order to obtain drum bottoms which are at least partly thicker than the wall of the drum body, and the entire drum may consist of a kind of steel able to withstand a very high heat or (and) able to withstand in a substantial degree the action of gases, vapors, liquids and other substances able to attack the material of said body or drum. Another feature of drums designed according to this invention is that their inner surface is smooth.

In order to render it possible to comprehend fully the essence and importance of the invention it is thought proper to dwell in a certain measure on the manner in which seamless drum-like vessels or receptacles have been manufactured up to now. This has been done by subjecting a solid block of steel, or another suitable material to a boring or pressing or rolling or drawing action whereby a tubular body is obtained which then must be turned off at its outer and its inner circumferential surface and its thereafter partly or completely closed either at only one end or at both ends by internal flanging. Drums for the purposes in view must have in their bottom so-called manholes which, if the drum is intended for use in high-pressure steam-boilers, but also if it is intended to be used as reaction vessel or the like in the carrying-out of a chemical process or the like, must be reinforced at the rim in order to increase the strength or resistibility of the drum bottoms, as requisite in the respective case. The manufacture of such drums in the just stated manner is expensive and requires very much time. In view of the continually increasing demand for drums of the type stated it is very desirous and important to design them in such a manner that the time of manufacture is considerably shortened and the manufacturing costs are essentially diminished. The present invention constitutes a complete solution of the problem.

The solution starts from a tubular member or body obtained by the known centrifugal casting method and being then subjected to the action of a forging press or the like by which the ends of the body are flanged inwardly, or contracted respectively, the outer and the inner circumferential surfaces being turned off or ground off or otherwise worked in any appropriate manner either prior to said contracting operation or thereafter for the purpose of obtaining smooth surfaces free from the impurities present especially at the inner surface, as well as from gas bubbles and the like.

The invention is illustrated diagrammatically and by way of example on the accompanying drawings on which Figure 1 is an axial section through a casting mold as used in the centrifugal casting method, and Figure 2 is an axial section through a partly finished drum designed according to this invention, some portions being indicated merely by dotted lines, all as fully dealt with hereinafter.

1 in Fig. 1 denotes the rotary casting mold which is supported on, and rotated by roll **3**. The mold is cylindrical and contains still the (already cold and solid) tubular body **2** obtained by the centrifugal casting method. The clear width of the mold is at its ends slightly larger than in the main portion or body whereby the drum **2** is provided with outer reinforcements **4**. At the ends of the mold are annular closing members **5**. While the mold is rotated in known manner by a suitable driving device with appropriate speed the liquid metal is introduced into it either at only one end or at both ends by a ladle **6**, as indicated in dotted lines at the left-hand end of Fig. 1. The mold is rotated, of course, with such a speed that the centrifugal force arising projects the liquid metal against the inner surface of the mold **1** so as to form therein the inwardly smooth wall of the drum.

The mold may be a chill mold or a suitably lined one.

When the drum body has been produced and has cooled down so as to have become solid it is removed from the mold, whereafter it is contracted at its ends by transforming these latter into a sort of inwardly directed flanges constituting either only partly closed drum bottoms or completely closed one, as requisite in the case concerned. In the example shown in Fig. 2 the bottoms are only partly closed, there being left large apertures **7** forming manholes, the rims of which are reinforced by the portions **4**, as clearly shown in the drawing. The bottoms of the drum may however be closed completely.

MAXIMILIAN VON SCHWARZ.

[illegible]

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[illegible]

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MAY 25, 1943.
BY A. P. C.

M. VON SCHWARZ
SEAMLESS DRUM FOR USE IN HIGH-PRESSURE BOILERS AND THE LIKE
Filed Oct. 31, 1938

Serial No. 238,039
2 Sheets-Sheet 1

Fig. 1.

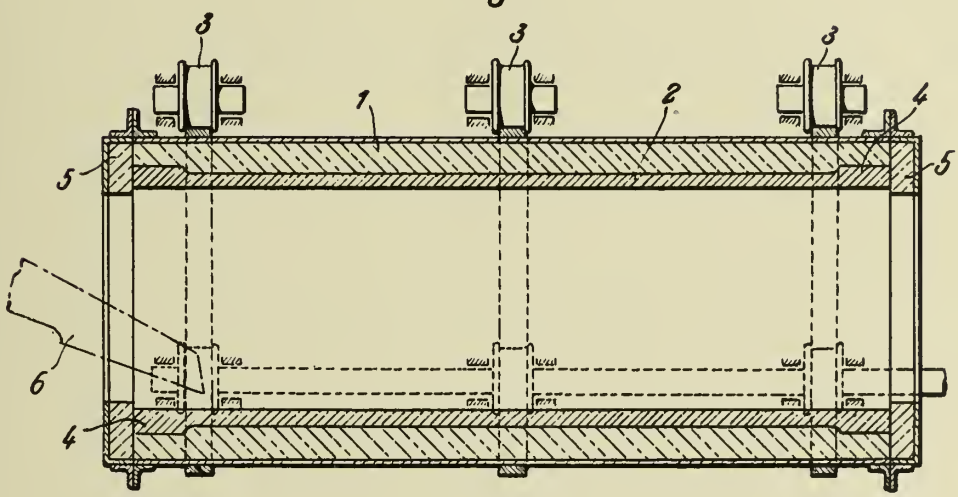
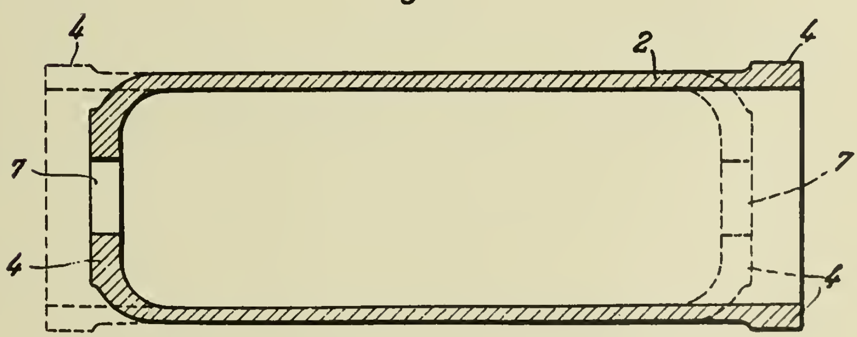


Fig. 2.



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2 Sheets-Sheet 2

Fig. 3.

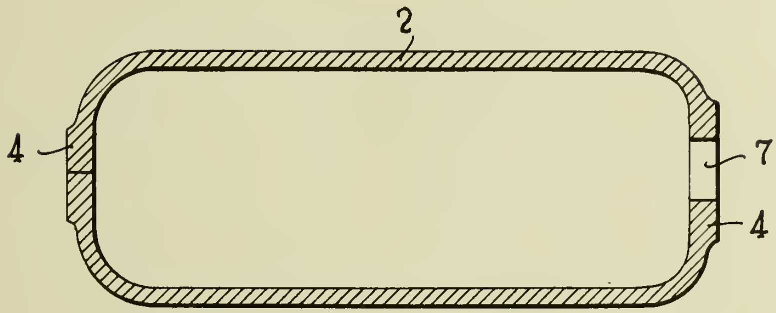
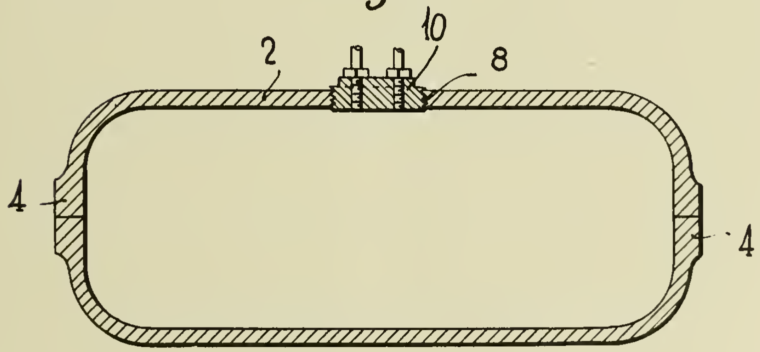


Fig. 4.



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ALIEN PROPERTY CUSTODIAN

BRAUN TUBE

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Application filed November 5, 1938

In Braun tubes with mixed electrostatic and electromagnetic deflection there is found on the fluorescent screen after a period of operation of several hours a dark line which extends transversely through the image field parallel to the magnetic and electric lines of force.

The line results from the impact of ions on the fluorescent screen. As well known the deflection in electrostatic fields is independent of the mass of the particles, whereas an electro-magnetic field causes a splitting of the bundle of rays owing to the different effect of particles of different mass. If, for example, in the case of a television tube, the screen is prodiced by mixed electrostatic and electro-magnetic deflection, the conditions are such that the ions in the electrostatic field are deflected in exactly the same fashion as the electrons, whereas in the magnetic field they are hardly appreciably affected. The ions accordingly pass over a fairly sharp line through the centre of the image field parallel to the magnetic and electric lines of the field.

The ions meet against the fluorescent screen with great kinetic energy. Since at the present time sulphide is the chief material employed for the screen, the black line results under the well known greatly reducing action of the ions by reduction of the zinc sulphide, which latter consists of a thin layer of metallicly separated zinc.

According to the invention, for the purpose of avoiding these interferences, there are provided in the space between the anode and the screen-producing deflecting means an additional pair of deflecting plates, the lines of force of which are parallel to the lines of force of the screen-producing deflecting condenser. The plates of this condenser have a potential of such nature applied to the same that the ray, in its position of rest, is deflected beyond the extreme edge of the image. Since this preliminary deflection takes place electrostatically the electrons and the ions are acted upon in equal fashion.

By means of a direct current traversing the deflecting coils the ray is again deflected back to the centre of the image field. Since this deflection occurs magnetically, it is only the electrons which respond to the same, whilst the interfering ions leave the image screen in the direction determined by the preliminary electrostatic deflection.

The deflection of the image point for producing the screen takes place as before by the usual methods.

A possible embodiment of the invention is illustrated in the drawings, in which

Fig. 1 shows the tube according to the invention in an axial section parallel to the planes of the main deflecting plates, whilst

Fig. 2 is a sectional view, vertical thereto, of the deflecting space.

In the drawings, 1 is the anode, 2 and 3 are the main deflecting plates for the electrostatic deflection in the direction of the lines of the image, 4 and 5 are the coils for the magnetic deflection vertical to the direction of the lines, and 6 and 7 are two sheet iron boxes, which in the known fashion act as pole shoes for the electromagnet.

According to the invention, there are located in the space between the anode 1 and the deflecting means 2/3 or 4/5 an additional pair of deflecting plates, which consist of two plates 8 and 9 of non-magnetic sheet metal. The deflecting plates 8 and 9 are applied with the aid of two potential sources 10 and 11 to potentials which are preferably symmetrical with relation to the anode potential, and which are so selected that electrons and ions are deflected in common by at least one-half of the width of the image field, the ray in its stationary condition accordingly impinging on the image screen 12 at the point P. In order now again to return the electrons alone to the centre point Q of the image screen an auxiliary direct current, which is supplied by a current source 13 indicated diagrammatically in Fig. 1, is passed through the deflecting coils 4 and 5. In this manner the electronic ray alone is deflected back to the centre of the image. The electronic ray accordingly passes to Q whilst the ionic ray passes to the point P situated outside of the image field.

The requisite auxiliary potentials can be derived from the existing mains apparatus. It is also possible to dispense with one of these potentials by connecting the plate 9 in direct fashion to the anode. The battery 10 and one of the additional leading in elements can then be omitted. If it is desired to avoid special leading in points entirely, the plate 8 can also be connected to a diaphragm situated within the tube. The sheet iron boxes 6 and 7 are preferably joined up with anode potential. An insulation of the boxes against the deflecting plates 2 or 3 is not absolutely essential.

The invention can naturally be employed with the same advantage in the case of tubes operating with purely magnetic deflection. In the same the interfering effect of the ions makes itself noticeable by the occurrence of a black spot of the centre of the image field.

KURT SCHLESINGER.

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BY A. P. C.

K. SCHLESINGER

BRAUN TUBE

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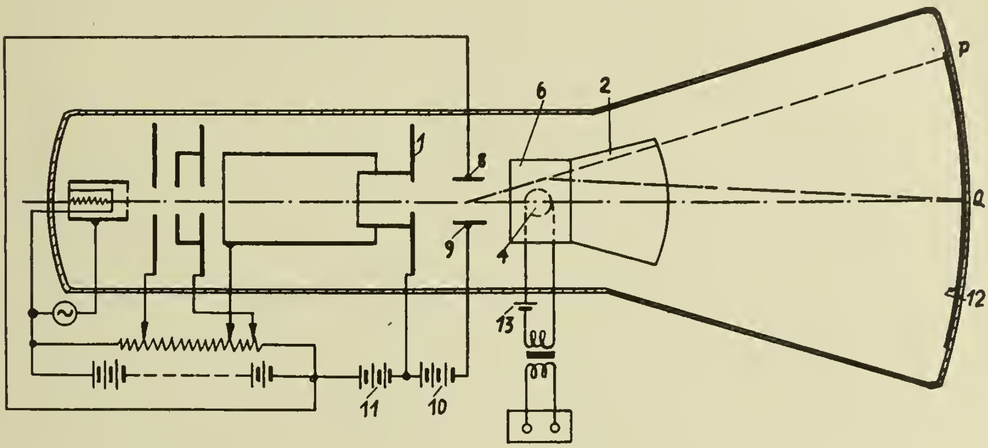

Fig.1

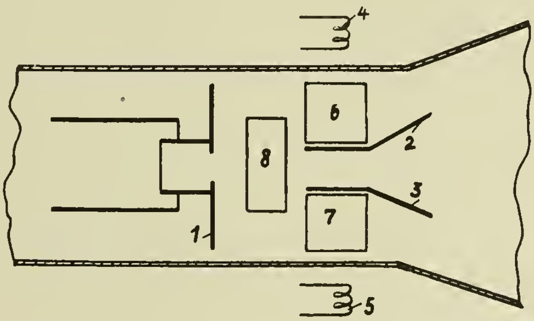

Fig.2

Inventor:

[signature]

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ALIEN PROPERTY CUSTODIAN

TYPEWRITING CALCULATING MACHINES, BOOKING MACHINES, AND SIMILAR MACHINES

Robert Anschütz, Zella-Mehlis, Germany; vested in the Alien Property Custodian

Application filed November 21, 1938

This invention relates to typewriting calculating machines, booking machines, and similar machines, with separate sets of number typing and calculating keys, a typewriting mechanism and a calculating mechanism, a drive for the typewriting mechanism, and a drive for the calculating mechanism. The expression "calculating mechanism" is intended to include the total taking mechanism which is connected to the calculating mechanism.

In machines of this class, as designed heretofore, the typewriting mechanism is connected to its drive through the medium of the totalizing slides forming part of the calculating mechanism. Obviously, the condition for satisfactory operation is exact synchronisation of the drive for the typewriting and of the drive for the calculating mechanism, but, notwithstanding the utmost care in this respect, it would happen that when a value was introduced or a total was taken, the typewriting mechanism was not connected to its drive at the proper time, and so the value, or total, as the case might be, was not typed. On the other hand, the machine requires a separate set of typing keys in addition to the set of calculating keys, as it is necessary that numbers should be typed independently of the calculating and total taking operations, and so it is not feasible to effect the typing of the numbers through the drive for the calculating mechanism.

This difficulty is eliminated, and failure through lack of synchronism is prevented, by arranging the typewriting mechanism so as to be connected to its own drive by the number of typing keys, and to the drive for the calculating mechanism by the calculating keys.

By these means, it is possible, on the one hand, to operate the typewriting mechanism independently of the calculating mechanism and, on the other hand, to operate it through the drive for the calculating mechanism independently of its own drive, when a value is introduced in the calculating mechanism.

In the drawings, Figs. 1 to 9 illustrate the first, and Figs. 10 to 14 illustrate the second constructional example. More particularly,

Fig. 1 is an elevation of the machine, viewed from its left-hand side, and partly broken away.

Fig. 2 is a partial elevation of the machine, viewed as in Fig. 1 but showing principally the parts involved in the calculating operation.

Fig. 3 is a perspective illustration of the parts shown in elevation in Fig. 2.

Figs. 4 and 5 are end elevations, viewed from the front of the machine, of a link in the transmission mechanism from the drive of the calculating mechanism to the typewriting mechanism, in the inactive and active position of the link, respectively.

Fig. 6 is a side elevation of the link, viewed in the direction of the arrow in Fig. 4.

Fig. 7 is an elevation which is similar to Fig. 2 but shows principally the parts involved in total taking.

Fig. 8 is a perspective illustration of the parts shown in elevation in Fig. 7.

Fig. 9 is a perspective illustration of a swinging frame forming part of the said transmission mechanism.

Fig. 10 is a side elevation of the machine equipped with the second constructional example, partly broken open.

Fig. 11 is a perspective illustration of a detail of Fig. 10.

Fig. 12 is a plan view of the lower frame of the machine.

Fig. 13 is a perspective illustration of certain parts shown in elevation in Fig. 10.

Fig. 14 shows in elevation a detail of Fig. 13.

General Description of the Machine

The machine is provided with a lower frame **1** which will be referred to as the "bearing frame," since it supports several important bearings, and with a detachable upper frame placed on the bearing frame **1**. The calculating keys **2** are mounted with its bars **3** to swing about a transverse rod **4** in the bearing frame **1** on which rod **4** the total taking key **104** is also mounted to swing ath the left-hand side of the bearing frame **1**. The bearing frame **1** also supports the driving shaft **23** for the calculating and totalizing mechanism which is arranged in a casing **35** on the front plate of the upper frame. A set of number typing keys **195** are arranged in the upper frame and the tail ends of their key bars **198** are notched and mounted to swing about the lower edge of a transverse bar **198***a* in the upper frame against which they are held by springs **198***b*. The type levers **89** of the typewriting mechanism are also arranged in the upper frame, together with a serrated driving shaft **196** for the typewriting mechanism. The usual paper carriage **189** and column totalizers **103** are mounted to slide on the top of the upper frame. A motor and reduction gearing, not shown, may be provided for rotating the driving shafts **23** and **196**.

I. The arrangement of the parts involved in the calculating operation of the first constructional example

Referring now to Figs. 1 to 9, the type bars **3** of the ten keys **2** in the calculating keyboard are mounted to swing on the rod **4** in the bearing frame **1**.

In the following, that calculating key **2** which bears the number "4," and the parts and mechanisms allotted to this key, will be described, it being understood that the other nine keys, and the parts and mechanisms allotted to them, are quite similar.

Each calculating key bar **3**, as shown for the "4" key bar in Fig. 3 is provided with an abutment **5** projecting from its lower edge, and in the normal position of the key bars **3** a spring **6** holds the abutment **5** of each bar against the rear side of a locking bar **7** secured in the bearing frame **1**. A pawl **9** is arranged at the right-hand side of each key bar **3** and slotted for sliding on the rod **4** and on a headed screw **8** secured in the key bar. At its front end, the pawl is equipped with a locking tooth **11** which a spring **10** holds against a step **12** in the front side of the locking bar **7**. When one of the calculating keys **2**, for instance, the "4" key, is depressed, the tooth **11** engages in a groove **13** in the lower side of the locking bar **7**, and holds the key **2** in its depressed position.

The tail end **14** of each key bar **3** is arranged to cooperate with a projection **15** on a coupling member **16**. This member **16** is mounted to slide on a camplate unit **19, 20**. One such unit **19, 20** is allotted to each key bar **3**, and seated on the driving shaft **23**. The driving shaft **23** is of square cross-section for accommodating square holes in the bosses of coupling pinions **24** allotted to the individual camplate units **19, 20** so that its rotation of the shaft **23** is not interfered with when the camplate units are arrested.

The coupling member **16** is mounted to slide on its camplate unit **19, 20**. This connection is effected by a pair of rivets **17**. In Fig. 3, and in some other figures, certain parts are shown at a distance from the members to which they are connected, for the sake of clearness. Thus, the two rivets **17** are shown in front of the camplate **19** while in fact the rivet at the left is inserted in a hole **19*a*** in the coupling member **16**, and the rivet at the right engages in the front end of a longitudinal slot **25** in the coupling member **16**. The rivets **17** extend through slots **18** in the camplates **19** and **20**. A pin **26** on the camplate **20** engages in the rear end of the slot **25**, and a spring **21** in the slot is inserted between the rivet **17** at the right, and the pin **26**. The spring **21** holds the projection **15** against the tail end **14** of the calculating key bar **3** and in this position a tooth **22** on the member **16** is out of mesh with the teeth of the corresponding pinion **24** on the shaft **23**. The shaft **23** rotates clockwise in the direction indicated by the arrow **94**. The reaction of the spring **21** against the pin **26** exerts a torque in anti-clockwise direction on the camplate unit **19, 20** whose camplates **19, 20** are rigidly connected but which, as a unit, is free to turn on the shaft **23**, as described. By this torque, a roller **27** on the camplate **19** is wedged against an inclined edge **28**, Fig. 2, of a catch **29** and the camplate unit **19, 20** is held in its normal position.

The catch **29**, as best seen in Fig. 12, is mounted to swing about the rod **4** with its boss **30**, and a spring **31** turns the catch clockwise and holds its tail end **32** against the flattened top **33** of the locking bar **7** in the initial position of the catch **29**. An incline **102** is arranged on the upper side of the catch **29** adjacent the wedging edge **28**.

The camplates **20** cooperate with totalizing slides **34**, Fig. 1, forming part of the calculating mechanism in the casing **35**. A roller **34*a*** at the lower end of each slide **34** is held against the edge of the corresponding camplate **20** by springs **174**. A rectangular arm **36** extends downwardly from each totalizing slide **34** at its lower end, and a wedge **37** extends to the left at right angles from the lower end of the arm. The lower edge **38** of the wedge **37** is arranged to strike a lug **39**, Figs. 3 to 6, on a U-shaped tilting member **40** and whose shanks **43** and **44** are pivoted on a pin **45** secured in the U-shaped upper portion of a link **46**. This link **46** is mounted to swing about a rod **54** with its boss **53**. The rod **54** is supported by a pair of brackets **56** and **55** which are secured to a channel-section transverse bar **57**, Fig. 2, by screws **58**. A spring **60** tends to turn each link **46** anti-clockwise about the rod **54** and this movement is limited by a shaft **59** in the brackets **55** and **56**. The other ends of the springs are connected to a comb-shaped bar **61**, Fig. 2, which is connected to the bar **57** by screws **62**.

A torsion spring **47**, Fig. 6, on the pivot **45** turns the tilting member **40** clockwise about such pivot **45**, as viewed in Fig. 4, until the edges **48** and **49** of the shanks **43** and **44** bear against the right-hand side **50** of the link **46**. This is the normal position of the tilting member **40**. A roller **51** is mounted to rotate about a rivet **52** on the tilting member **40**, and when the totalizing slide **34** descends and the lower edge **38** of the wedge **37** strikes the lug **39** of the tilting member **40**, the member **40** is moved into the position in Fig. 5 which is its active position and in which its roller **51** is in line with the camplate **19**. In the active position of the tilting member **40**, a point **41** on the wedge **37** at the lower end of the arm **36** bears against the right-hand side **42** of the tilting member **40**, holding the member in its active position against the reaction of the torsion spring **47**.

Pivoted to the lower end of each link **46** is one part **63** of a two-part connecting rod whose other part **64** is pivotally connected to the lower end of a swinging lever **65**. The parts **63** and **64** of the connecting rod are slotted at **66** for adjusting the effective length of the connecting rod, and clamping screws **65** are provided for holding the parts in adjusted position. The swinging levers **65** are mounted to swing about a rod **67**, Fig. 3, which is supported at its ends by bearing brackets **68** and **69**, the brackets **68, 69** being secured to a transverse plate **71** at the rear of the bearing frame **1** by screws **70**.

The upper end of each swinging lever **65**, is an arm **72** with a cam **73** for cooperation with an incline **74** at the end of an arm **75** on a selectable member, or three-armed lever, **76**. The three-armed levers **76** are mounted to swing about a shaft **77**, Figs. 8 and 9, of a swinging frame having a pair of parallel frame members **78** and **79**, a shaft **185** just below the shaft **77**, a central stay **77*a*** at the top of the frame, a journal **136** in the frame member **78**, and a journal **137** in the front end of the frame member **79**.

On the upwardly projecting vertical arm **80** of each selectable member or three-armed lever **76** an extension **81** is pivotally arranged about a screw **82**. By means of an arcuate slot **83** and

a headed screw 84 inserted in the arm 80 and projecting through the slot, the angular position of the extension 81 with respect to the arm 80 can be varied. The upper end of the extension 81 is kinked and connected to the lower arm 86 of a double-armed lever 87 by a rod 85. The double-armed lever 87 is fulcrumed at 88 and its upper arm is operatively connected to a type lever 89 which is thrown against the platen in the carriage 90 when the double-armed lever 87, is turned clockwise. A hook 197, Fig. 1, is pivoted to the double-armed lever 87 at one end and with its free end is arranged to engage in one of the serrations of the driving shaft 196 when a number typing key 195 is depressed, causing the spring-controlled rod 199 to pull down the hook 197, so that the double-armed lever 87 is turned clockwise, and the type lever 89 is operated.

It is understood that the parts which have been described with reference to the calculating key 2 for the number "4," and its key bar 3, are also provided for the calculating keys 2 and their key bars 3 which bear the numbers "0" to "3," and "5" to "9."

The links 46 and the swinging levers 65 are spaced on the respective rods 54 and 67 by spacing sleeves, Fig. 9 shows spacers 93 for the selectable members, or three-armed levers, 76, on the shaft 77.

II. The calculating operation

When, for calculating, for instance, the number "4" in the calculating mechanism, the calculating key 2 for the number "4" is depressed, its key bar 3 is turned clockwise about the rod 4 and the pawl 9 partakes in this movement. Its tooth 11 slides off the step 12 and at the end of the movement of key bar 3 under the action of the spring 10 engages in the groove 13 in the locking bar 7, and the key bar 3 is held in its depressed position. When the key bar 3 is depressed, its tail end 14 releases the projection 15 on the coupling member 16, and the spring 21 throws the tooth 22 in between the teeth of the pinion 24. The camplates 19 and 20 now rotate together and with the continuously rotating driving shaft 23 which, as mentioned, is rotated in the direction of arrow 94 by the motor—not shown—of the machine. The corresponding totalizing slide 34, under the action of its spring 174 descends from the elevated portion of the rotating camplate 20 to its depressed position, and the totalizing slide 34, through the inclined edge 38 of the wedge 37 at the lower end of its arm 36, engages the lug 39 of the tilting member 40 on the link 46, and turns this member 40 anti-clockwise against the action of the torsion spring 47, until the edge 95 of the tilting member 40 bears against the edge 96 of the link 46, Fig. 5. When the edges 95 and 96 encounter, the edge 38 of the wedge 37 has moved off the lug 39 of the tilting member 40. The point 41 of the wedge 37 now bears against the side 42 of the lug 39 and holds the tilting member 40 in its active position with respect to the camplate 19. The roller 51 of the tilting member 40 is now engaged by the edge 97 of the camplate 19 but for the present the link 46 is not operated as the depressed portion of the camplate 19 now moves past the roller 51. However, when the camplate 19 has performed about one-half of a revolution, the ascending edge 98 of the camplate which leads to its elevated portion 99, begins to operate the transmission mechanism, that is, the train of parts between the camplate 19 and the selectable members or three-armed levers, 76. The ascending edge 98 bears against the roller 51 on the tilting member 40 and, upon further rotation of the camplate 19, turns the tilting member 40, and the link 46 clockwise about the rod 54 against the spring 60. The connecting rod 63, 64 is moved in the direction of the arrow 100 in Fig. 3, the swinging lever 65 is turned clockwise about the rod 67, and its cam 73 acts on the incline 74 of the arm 75 of the selectable member, or three-armed lever 76. This is a one-way connection since 73 acts on 74 only when the swinging lever 65 turns clockwise. The selectable member, or three-armed lever, 76, is now turned anti-clockwise about the shaft 77 in the swinging frame 78, 79. This causes the connecting rod 85 to move in the direction of the arrow 100 and the double-armed lever 87 is turned clockwise about its fulcrum 88, and the type lever 89 for the number "4" is thrown against the platen 90 in the carriage 189.

When the type lever 89 has performed its stroke, the camplate 19 has rotated so far as to move its elevated portion 99 away from the roller 51. The consequence is that the link 46 and its tilting member 40 return into their initial position under the pull of the spring 60, turning anti-clockwise about the rod 54 until the link 46 bears against the shaft 59. When the link 46 returns into the initial position, as shown in Fig. 2, the swinging lever 65 is turned anti-clockwise about the rod 67 by the connecting rod 63, 64, and assumes the position in Fig. 2. The projection 73 of its arm 72 releases the incline 74 of the lever 76, and the lever 76, with its extension 81, the connecting rod 85, and the double-armed lever 87 return into their initial positions, Fig. 2, under the action of the type lever 89 which returns by gravity.

Upon further rotation of the camplate unit 19, 20 in the direction of arrow 94 the elevated portion of the cam 20 elevates the totalizing slide 34 through its roller 34*a* against the action of spring 174. The point 41 of the wedge 37 on the arm 36 of the totalizing slide 34 in consequence releases the lug 39 of the tilting member 40 and this member, under the action of the torsion spring 47, turns clockwise, as viewed in Fig. 5, about its pivot 45 and back into the inactive position Fig. 4, in which the edges 48 and 49 of the shanks 43 and 44 of the U-shaped member 40 bear against the side 50 of the link 46. The roller 51 on the tilting member 40 also moves beyond reach of the camplate 19.

A short time before the camplate unit 19, 20 and the coupling member 16 have completed their revolution, the projection 15 of the member 16 acts on a deflected portion 101 of the pawl 9 which is in the path of the projection, 15, and shifts the pawl to the front against the spring 10. The tooth 11 of the pawl 9 leaves the groove 13 in the locking bar 7 and the spring 6 returns the calculating key bar 3 and the pawl 9 into their normal positions, as shown in Figs. 2 and 3. The tail end 14 of the calculating key bar 3 returns into the path of the projection 15 of the coupling member 16.

At the same time, the roller 27 on the camplate 19 acts on the incline 102 of the catch 29, turning the catch 29 anti-clockwise about the rod 4 against the spring 31. Just before the camplate unit 19, 20 has completed its revolution the projection 15 of the coupling member 16 strikes the tail end 14 of the calculating key bar 3, as described, and this, in addition to the throwing

out of the pawl 9, causes the tooth 22 of the coupling member to clear the pinion 24 against the spring 21, and the rotation of the camplate unit 19, 20 is now interrupted. When the roller 27 on the camplate 19 has left the incline 102 of the catch 29, the spring 31 returns the catch 29 into its initial position, Fig. 2, the roller 27 is wedged against the edge 28 of the catch 29, and the camplate unit 19, 20 and the coupling member 16 are held in their normal position.

III. Total taking

Assume that one of the column totalizers 103 indicates, in any decimal place, the number "4". This value "4" is now typed upon depression of the total taking key 104, Figs. 7 and 8 and the total taking operation started thereby, by the mechanism according to the invention, as follows:

When the total taking key 104 is depressed, its key bar 105 turns clockwise about the rod 4, and a pawl 106 which is fulcrumed on the key bar 105, partakes in this movement. The tooth 107 of the pawl 106 leaves the step 12 in the locking bar 7 and jumps into the groove 13 in its lower side, holding the total taking key 104 in its depressed position.

When the key bar 105 is depressed, its tail end 108 moves out of active position with respect to a coupling member 109 which is arranged on the camplate unit 113, 112 of the total taking mechanism in a manner similar to the arrangement described with reference to the camplate units 19, 20 of the calculating mechanism. The spring 110 of the coupling member 109 now moves the member into engagement with a coupling pinion 111 on the driving shaft 23, which, it will be remembered, rotates continuously, in the direction of the arrow 94. The camplate unit 113, 112 is now coupled to the shaft 23 for one revolution.

When the camplate unit 113, 112 begins to rotate in the direction of the arrow 94, a roller 114*a* at the lower end of an unlocking slide 114—which is only partly shown in Figs. 7 and 8—descends on the descending portion of the camplate 112 under the action of springs 115. A pin 116 on the descending unlocking slide 114 acts on a double-armed lever 117 which is fulcrumed about a headed screw 118 on a bellcrank 119. A spring 120 which connects the rear end of the double-armed lever 117 to the shorter arm of the bellcrank 119 tends to turn the double-armed lever 117 anti-clockwise until an abutment 121 on the double-armed lever 117 bears against the front edge 122 of the bellcrank 119. When the pin 116 on the unlocking slide 114 acts on the lever 117, the lever 117 and the bellcrank 119 are turned clockwise about a headed screw 123 about which the bellcrank 119 is fulcrumed. The front edge 122 of the bellcrank 119 acts on a lug 124 of a slide 125. This slide is equipped with slots 125*a* by which it is guided on headed screws 125*b* supported by the member 78 of the swinging frame. A spring attached to the journal 136 pulls the slide 125 to the rear. The bellcrank 119 shifts the slide 125 forwards, and a lug 126 which is deflected from the slide engages in a slot 127 in the upper end of a latch 128 and couples the latch to the swinging frame 78, 79. At its lower end, the latch is fulcrumed on a one-armed feeler 134 whose front end 133 is held against the camplate 113 with its free end 133 by a spring 133*a*.

During the zero setting in the calculating mechanism a selector cam shaft 129, Figs. 7 and 9, is rotated clockwise to place that selector cam 130 which corresponds to the number "4" in line with the third arm 131 of the corresponding selectable member, or three-armed lever 76.

When upon further rotation of the camplate unit 113, 112 in the direction of the arrow 94, the ascending portion 132, of the camplate 113 acts on the end 133 of the feeler 134 and turns the feeler clockwise about its fulcrum screw 135. The latch 128 partakes in this movement and, through its slot 127 and the lug 126 of the slide 125, pulls down the slide and the swinging frame 77, 78, 79 is turned clockwise about its journals 136 and 137. Immediately upon the beginning of the movement of the swinging frame, and the raising of the shaft 77, with the selectable members, or three-armed levers 76 on the shaft, the third arm 131 of the lever 76 which is allotted to the number "4" strikes the corresponding selector cam 130 on the shaft 129. This causes the lever 76 to turn about the shaft 77 as the swinging frame moves further, in anticlockwise direction, so that the extension 81 of the lever 76 pulls the connecting rod 85 which is pivoted to the extension 81, in the direction of the arrow 100, Fig. 8. The connecting rod 85 swings the double-armed lever 87 allotted to the type lever 89 for the number "4" clockwise about the fulcrum 88, and the type lever 89 allotted to the number "4" now strikes the number on the platen.

When the camplate unit 113, 112 rotates further, the elevated portion of the camplate 133 releases the end 133 of the feeler 134, so that the feeler 134 and the swinging frame 77, 78, 79 are free to return into their initial positions, as shown in Fig. 7. Similarly, the elevated portion of the camplate 112 raises the unlocking slide 114 and the pin 116 of the slide releases the double-armed lever 117 and breaks the connection between the lug 126 on the slide 125 and the slot 127 in the latch 128. When the camplate unit 113, 112 has almost completed its revolution, the kinked end 138 of a slide 139 in Figs. 7 and 8, descends and turns the pawl 106 anti-clockwise. The tooth 107 of the pawl leaves the groove 13 in the locking bar 7, and the total taking key bar 105 of the total taking key 104, together with the pawl 106, returns into its initial position, Fig. 7, under the action of the spring 140. When the key bar 105 is in its initial position, the coupling member 109, after a complete revolution of the camplate unit 113, 112, bears against the tail end 108 of the key bar, and the camplate unit 113, 112 is uncoupled from the continuously rotating driving shaft 23.

At the same time, the selector cam shaft 129 is returned into its initial position, so that now all parts are in their initial positions, as shown in Fig. 7.

IV. The arrangement of the parts involved in the calculating operation of the second constructional example

The arrangement and operation of the parts of the second constructional example will now be described with reference to Figs. 10 to 14.

The camplate units 19, 20, the key bars 3 of the calculating keys 2, the coupling member 16, and the pinion 24 allotted to each camplate unit 19, 20, as shown in Fig. 12, are similar to those illustrated in Fig. 3, and will not be described again. As in the previous example, the parts allotted to each calculating key are alike for all

keys and therefore only the parts corresponding to the number "4" will be described.

The catch 29 allotted to the calculating key bar 3 for the number "4," Fig. 12, is mounted to swing about the rod 4 with its boss 30, as described. Mounted to swing on the boss 30 by bosses 141 and 142 is a link 143. The bosses 141 and 142 of the link 143 space the calculating key bar 3 from the link 143, and the link 143 from the catch 29, so that the link 143 is held against lateral displacement, as shown in Fig. 12. A spring 144, Fig. 13, whose rear end is attached to the upper end 145 of the link 143—the end being kinked to the right—and whose front end is attached to a pin 146 on the calculating key bar 3, turns the link 143 clockwise about the shaft 4 and the initial position of the link 143 is defined by a roller 149 on a rivet 148 at the lower end 147 of the link 143 bearing against the edge of the camplate 19. As the camplate unit 19, 20 rotates in the direction of the arrow 94 the elevated portion 99 of the camplate 19 acts on the roller 149 on the link 143.

The kinked upper end of the link 143 has a rear edge 150 for engaging the front end 151 of a push rod 152. This arrangement corresponds to the one-way connection 73—74 in Fig. 3. In the initial position of the parts, as shown in Figs. 10 and 13, the push rod 152 is raised and its front end 151 clears the edge 150 of the link 143. The push rod 152 is slotted near its rear end at 153 and is mounted to slide on, and to swing about, a rod 154 secured in the upper frame of the machine. The rear ends 151 of the push rods 152 are guided between spacing sleeves 155 on the rod 154. The front ends of the push rods are guided in slots of a comb 156. The comb 156 is provided for this purpose with an inclined rib 158 which extends downwards along its front. The push rod 152 for the number "4" is guided in a slot 157 in the rib 158. At the side of the slot 157, a long slot 159 is made in the comb 156 for the reception of the totalizing slide 34 allotted to the number "4," and at its right-hand side is made an extension 160 for a pin 161 to pass as the slide descends under the control of its springs 174 and the camplate 20, as described above. The pin 161 is arranged to bear against the upper edge 162 of the push rod 152.

The comb 156 for guiding the totalizing slides 34 and the push rods 152 is connected to a bar 163 for the roller lock of the key bars of the number typing keys 195. The bar is secured in the upper frame of the machine. A strip 164 Figs. 3 and 4, is equipped with eyes 165 for a spring 166 for each push rod 152 which is connected to a pin 167 on the corresponding push rod 152. The spring 166 urges the push rod 152 in upward and forward direction, as indicated by the arrow 168 in Fig. 13, and the rear end 169 of the slot 153 bears against the rod 154, defining the initial position of the push rod 152.

At its rear end, the push rod has an upwardly directed portion 170 and the rear end of this portion is reinforced by a plate 171 for imparting a wider rear edge 172 to the push rod 152. This rear edge 172 of the slide 152 is arranged to cooperate with a downward extension 173 on the lower arm 86 of the double-armed lever 87 which is operatively connected to the type lever 89 for the number "4." As mentioned, the parts which have been described, are allotted also to the other calculating keys 2 from "0" to "3," and from "5" to "9."

V. The calculating operation

When, for calculating, by way of example, the value "4," the calculating key 2 corresponding to the number "4" is depressed, and its key bar 3 swung, the camplate unit 19, 20 is coupled with the shaft 23 for a full revolution in the direction of the arrow 94, in the manner described in chapter II. The corresponding totalizing slide 34 descends on the descending portion of the camplate 20 under the action of its spring 174. When the totalizing slide 34 descends its pin 161 moves through the recess 160 in the totalizing slide guiding comb 156, engages the upper edge 162 of the pushrod 152 and swings the rod clockwise about the rod 154 against the spring 166. This, as shown in Fig. 4, places the front end 151 of the push rod 152 into the path of the edge 150 on the link 143.

At the beginning of the revolution of the camplate unit, 19, 20, the camplate 19 moves along the roller 149 of the link 143 with its edge 97 without influencing the link 143 and upon further rotation in the direction of the arrow 94 the configuration of the camplate 20 allows the totalizing slide 34 to remain in the position illustrated in Fig. 14, for the present. The pin 161 consequently holds the pushrod 152 down and its front end 151 remains in the path of the edge 150 of the link 143. Later, the ascending edge 98 of the camplate 19, through the roller 149 swings the link 143 about the shaft 4 in anti-clockwise direction. The push rod 152 is now shifted in the direction of the arrow 100, Fig. 13, against the spring 166, its rear edge 172 acts on the extension 173 of the arm 86 on the double-armed lever 87, and swings it clockwise about the fulcrum 88. This movement of the double-armed lever 87 causes the type lever 89, which corresponds to the number "4," to be thrown against the platen 90 on the paper carriage 189.

As described with reference to the first constructional example, the parts which are operatively connected to the double-armed lever 76 are involved when the push rod 152 is pushed back in the direction of the arrow 100, and the clockwise swinging of the double-armed lever 87 caused thereby. Such parts are the connecting rod 85, the extension 81, and the selectable member 76 which, in this instance, is without the arm 75 in the first constructional example. This movement of the member 76, however, does not produce any effect.

When the type on the lever 89 has been typed, the camplate unit 19 and 20 has rotated so far that the roller 149 of the link 143 is again released by the elevated portion 99 of the camplate 19, whereby the link 143 under the pull of its spring 144, is returned clockwise into its initial position, as shown in Fig. 10, in which the roller 149 of the link 143 is again on the edge 97 of the camplate 19.

When the link 143 returns into the initial position in Fig. 10, its edge 150 releases the front end 151 of the push rod 152 and the spring 166 fetches the push rod forward against the arrow 100, until the end 169 of its slot 153 bears against the rod 154. The rear edge 172 of the push rod 152 now releases the extension 173 on the arm 86 of the double-armed lever 87 and the type lever 89, returning by gravity, moves the double armed lever 87 into the initial position shown in Fig. 10.

As the camplates 19 and 20 rotate further, the elevated portion of the camplate 20, through the roller 34*a* of the toalizing slide 34, raises this slide against the action of its spring 174. The

pin 161 of the totalizing slide 34 recedes from the upper edge 162 of the push rod 152 and the spring 166, acting in the direction of the arrow 168, turns the push rod 152 anti-clockwise about the pin 154 and into the normal position shown in Fig. 10, in which the upper edge 162 of the push rod 152 is arrested by the upper end of the guiding slot 157.

When the camplates 19 and 20, and the coupling member 16, have performed a complete revolution, they are uncoupled from the continuously rotating shaft 23, as described in chapter II, and the calculating key bar 3 returns into its normal position.

VI. Preventing distortion of the swinging frame

As described in chapter III, the swinging frame 77, 78, 79 shown in Figs. 7, 8 and 9 is moved clockwise about its journals 136 and 137 upon rotation of the total taking camplate 113 at the left of the machine, through the feeler 134, the latch 128, the lug 126 of the slide 125. This produces one sided stress in the swinging frame, particularly when typing a number of higher order, i. e., "9" or some adjacent number. For instance, when the number "9" is typed, whose selectable member, or three-armed lever 76 is at the right-hand end of the shaft 77, and when the arm 131 of this member engages the selector cam 130 on the selector cam shaft 129 which corresponds to the number "9", at the beginning of the movement of the swinging frame, the frame member 79 is restrained at the right-hand side of the swinging frame while the frame member 78 at the left-hand side is free to move on, causing distortion of the frame. This is prevented by the following arrangement:

A shaft 175 is mounted to rotate in the bearing brackets 68 and 69, Fig. 3, which support the rod 67 for the swinging levers 65, and on the shaft 175 are secured the bosses 176, 177 of forks 178 and 179, and a check 180, with a projection 188 at its upper end. A spring 181 which is attached to the check 180 at one end, and to the transverse plate 71, Fig. 2, at the other, tending to turn the shaft 175 in the direction of the arrow 182, and to hold the projection 188 of the check against the plate 71. The slots 183 and 184 of the forks 178 and 179 engage the shaft 185 of the swinging frame in the normal position of the frame, Fig. 8. In this normal position of the frame, the forks are held inclined in forward direction, against the action of the spring 181. When the swinging frame is turned clockwise, as described in chapter III, the left-hand end of the shaft 185 acts on the edge 186 of the fork 178 and turns the fork and the shaft 175 in the direction of the arrow 182, Fig. 3. The fork 179 engages the right-hand end of the shaft 185 with its edge 187 and distortion of the swinging frame is prevented by this fork 179 acting on the right-hand end of the shaft 185. When the swinging frame has turned through a given angle in clockwise direction, the shaft 175 has turned in the direction of the arrow so far that the projection 188 of the check 180 engages the front face of the plate 71. The shaft 175 and the forks 178 and 179 are now arrested against moving in the direction of the arrow 182 and when the swinging frame turns further, the shaft leaves the slots 183 and 184 of the forks 178 and 179. After the shaft 185 has cleared the forks 178 and 179, the spring 181 forces the projection 188 against the plate 71 and holds the shaft 175 with its forks 178 and 179 in position. When the swinging frame returns into its initial position, as shown in Fig. 7, its shaft 185 again engages in the slots 183 and 184 of the forks 178 and 179 and turns the forks 178 and 179, the shaft 175 and the check 180 against the spring 181 and against the arrow 182, into the normal position illustrated in Figs. 1, 2 and 3.

It will appear from the foregoing description that the connection betwen the camplates 19 and the type levers 89 is interrupted in the non-calculating condition of the machine, by the roller 51 on the tilting member 40 not being in active position, Fig. 4, or the push rod 152 being elevated, Fig. 10, beyond reach of the edge 150 on the link 143. The purpose for which this arrangement is provided, will now be described.

Suppose that in any position of the paper carriage 189 none of the column totalizers 103 is in active position and that the operator depresses one of the calculating keys 2 by mistake. The corresponding totalizing slide 34 can not descend since the controlling plate 190 arranged to each totalizer 103 (Fig. 10) does not engage the unlocking lever 191 (Figs. 10 and 11). There through the locking lever 192 is not released and the locking beam 193 does not swing out in the clockwise direction. Therefore the slide 34 which coacts with its incline 194 upon the locking beam 193 is held in its position and therefore it does not descend. The camplate unit 19, 20 allotted to the calculating key which has been depressed by mistake, is coupled to, and rotates with, the driving shaft 23, but, since the totalizing slide 34 does not descend, its wedge 37, Figs. 3 and 5, cannot move the member 40 into active position, nor can the edge 150 of the link 143 act on the end 151 of the push rod 152. In both cases, the corresponding type lever 89 is not operated. Consequently, values not intentionally introduced, and consequently not calculated, will not be typed.

As described, when numbers are typed by the number typing keys 195 from "0" to "9", the type levers 89 are operated by the usual power drive, that is from the serrated or cam shaft 196 rotating clockwise continuously. Depression of a key 195 connects the hook 197 to the shaft 196 through key bar 198 and member 199 the double-armed lever 87 is turned clockwise and the type lever 89 is thrown against the platen 90. Consequently, while upon operation of the calculating keys 2 and the total taking key 104 the type levers 89 are under the control of the driving shaft 23 for the calculating mechanism they are under the control of the shaft 196 when the number typing keys 195 are operated.

It is understood that the expression "total taking" in the foregoing description is intended to include any kind of total taking and also subtotal taking.

ROBERT ANSCHÜTZ.

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MAY 25, 1943.

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Filed Nov. 21, 1938

Serial No. 241,672

9 Sheets-Sheet 1

Fig. 1.

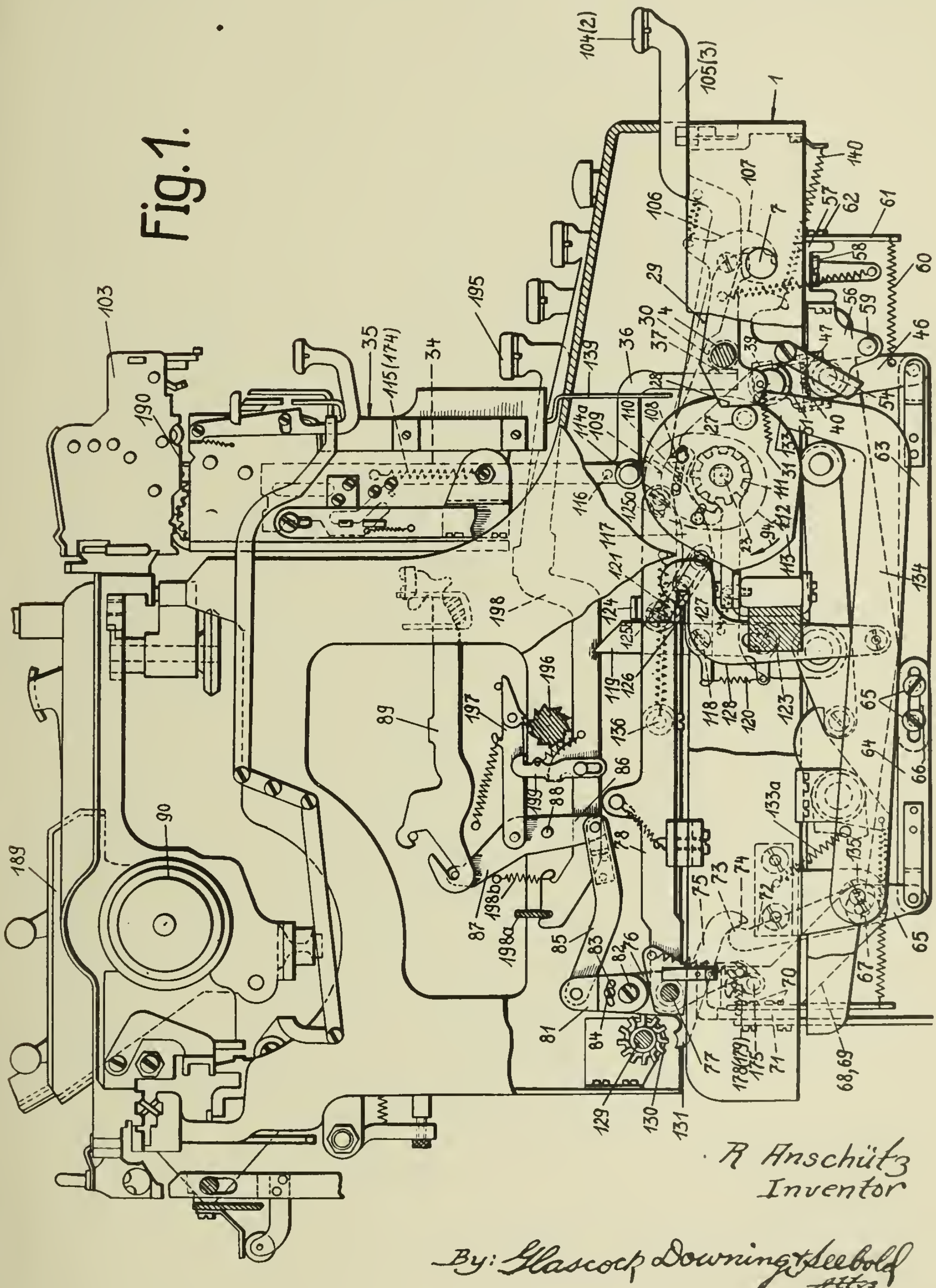

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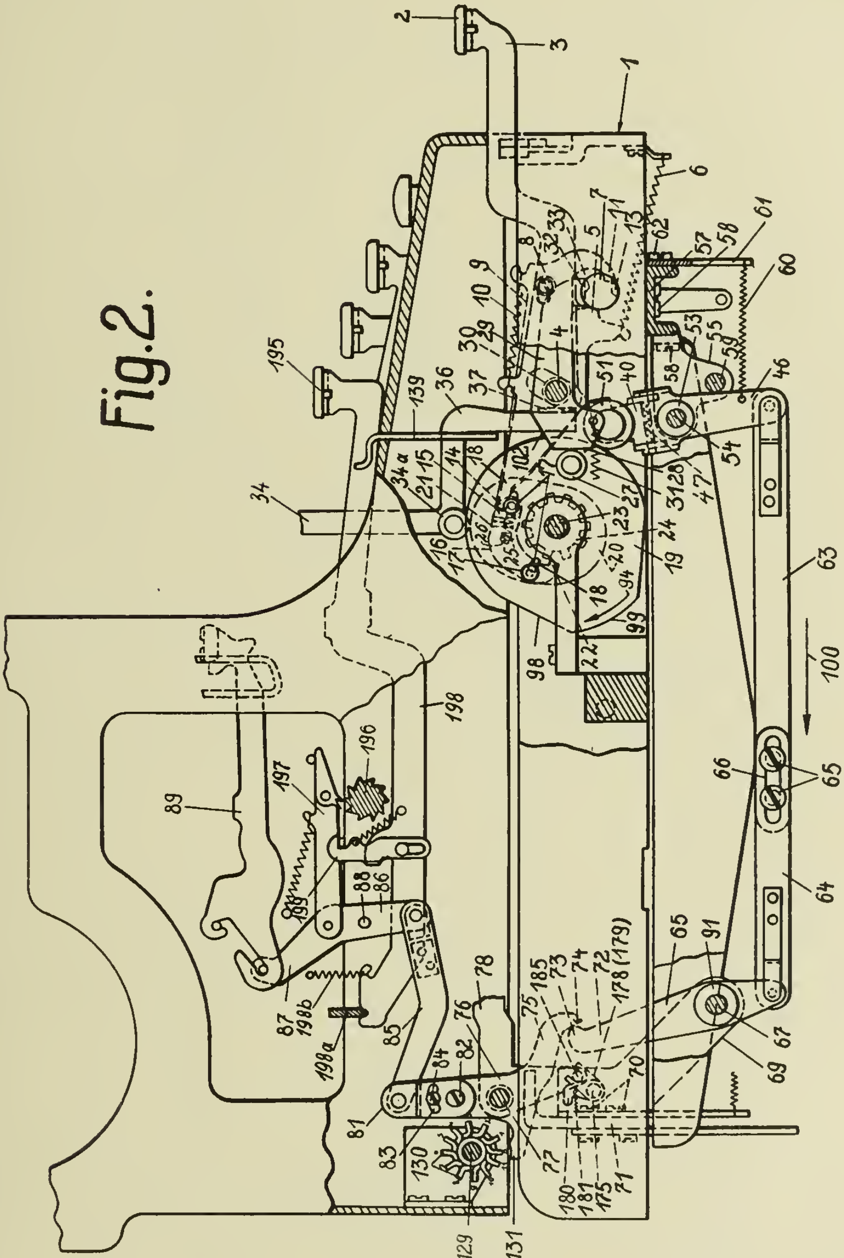
Fig.2.



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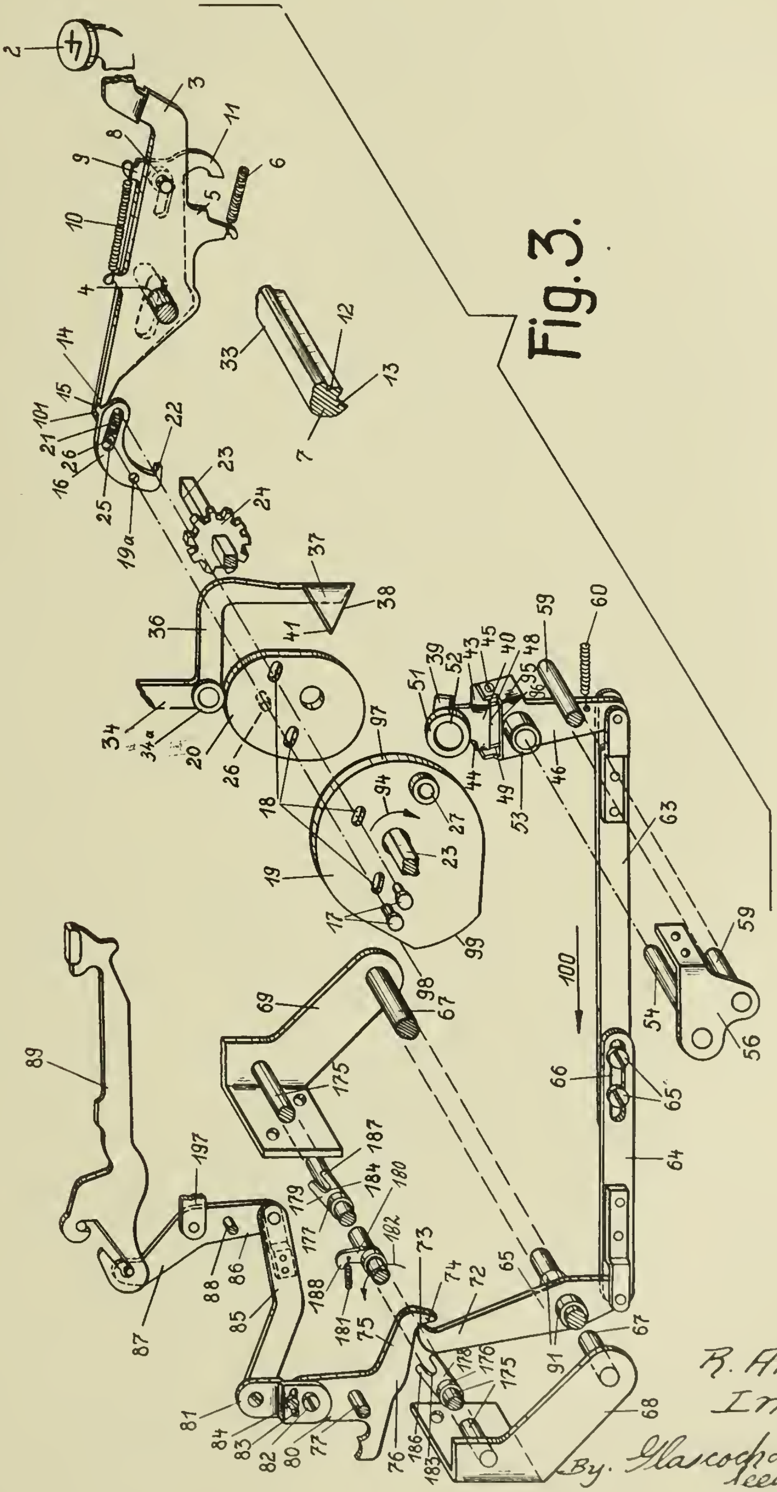

Fig. 3.

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Fig. 4

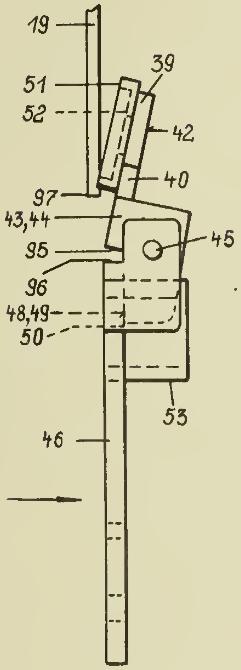

Fig. 5

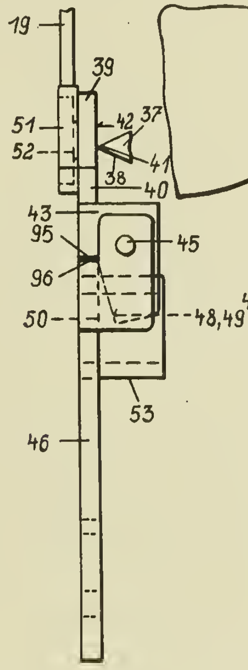

Fig. 6.

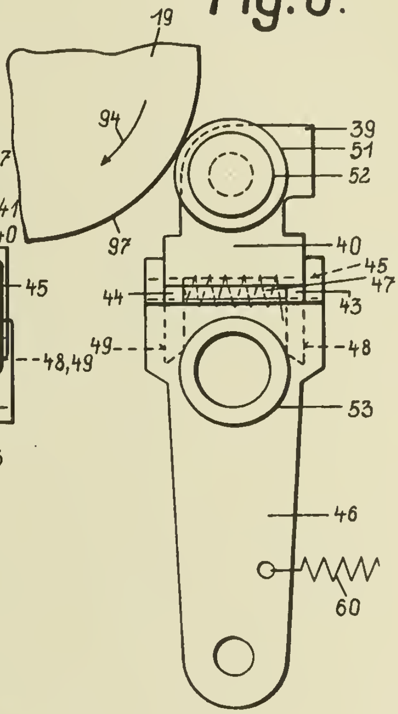

Fig. 9

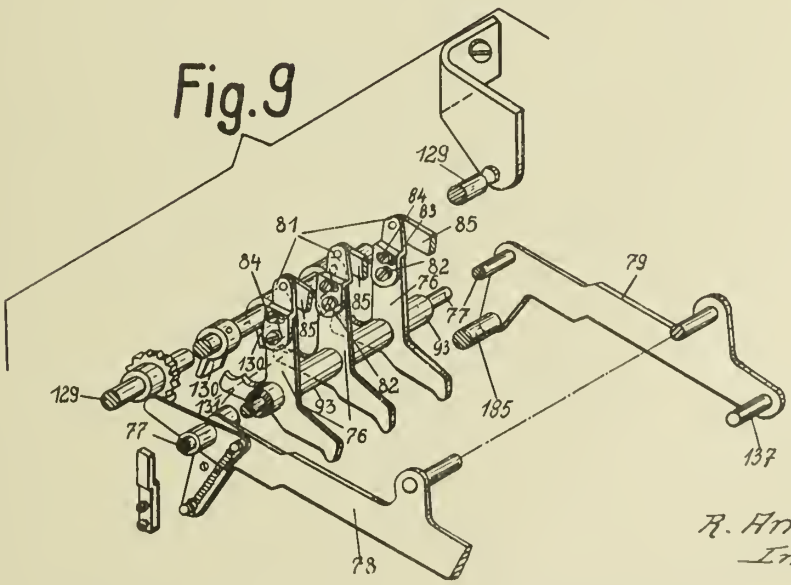

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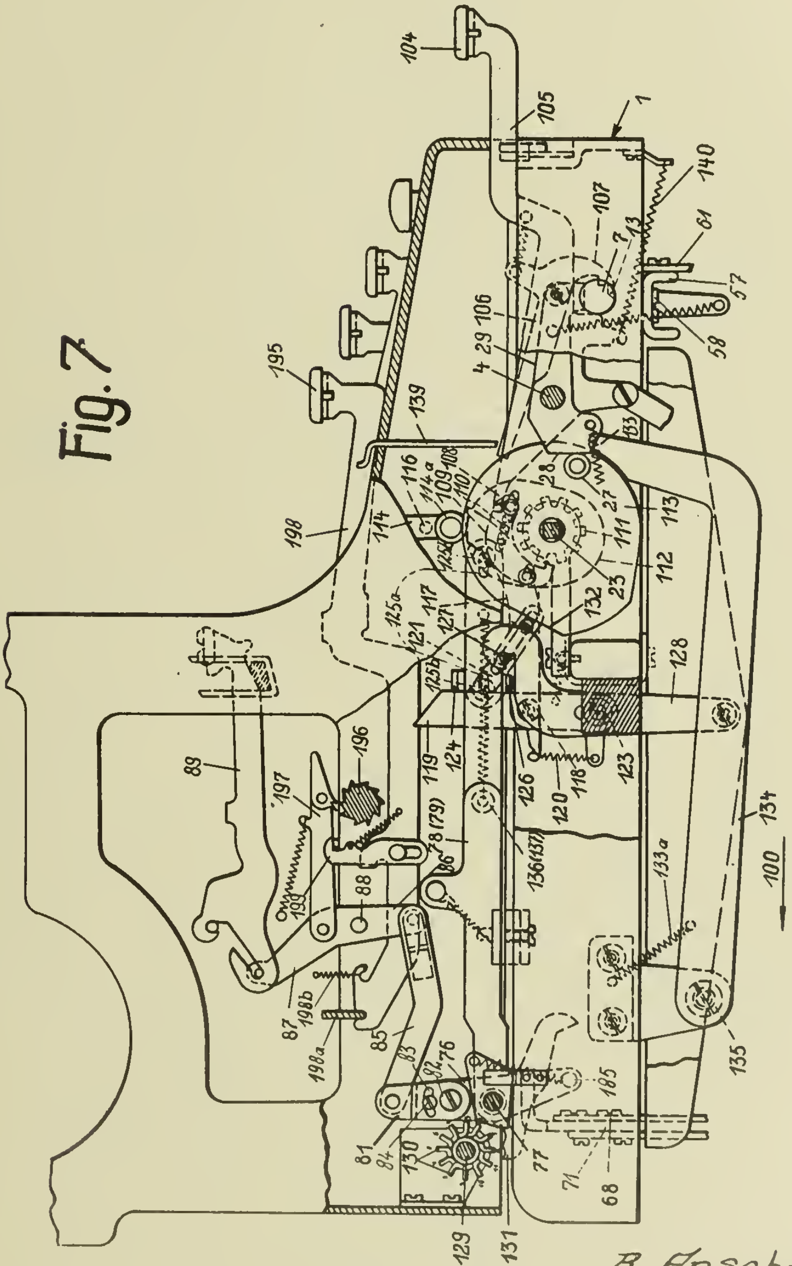
Fig. 7



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MAY 25, 1943.

BY A. P. C.

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TYPEWRITING CALCULATING MACHINES, BOOKING MACHINES, AND SIMILAR MACHINES

Filed Nov. 21, 1938

Serial No. 241,672

9 Sheets-Sheet 6

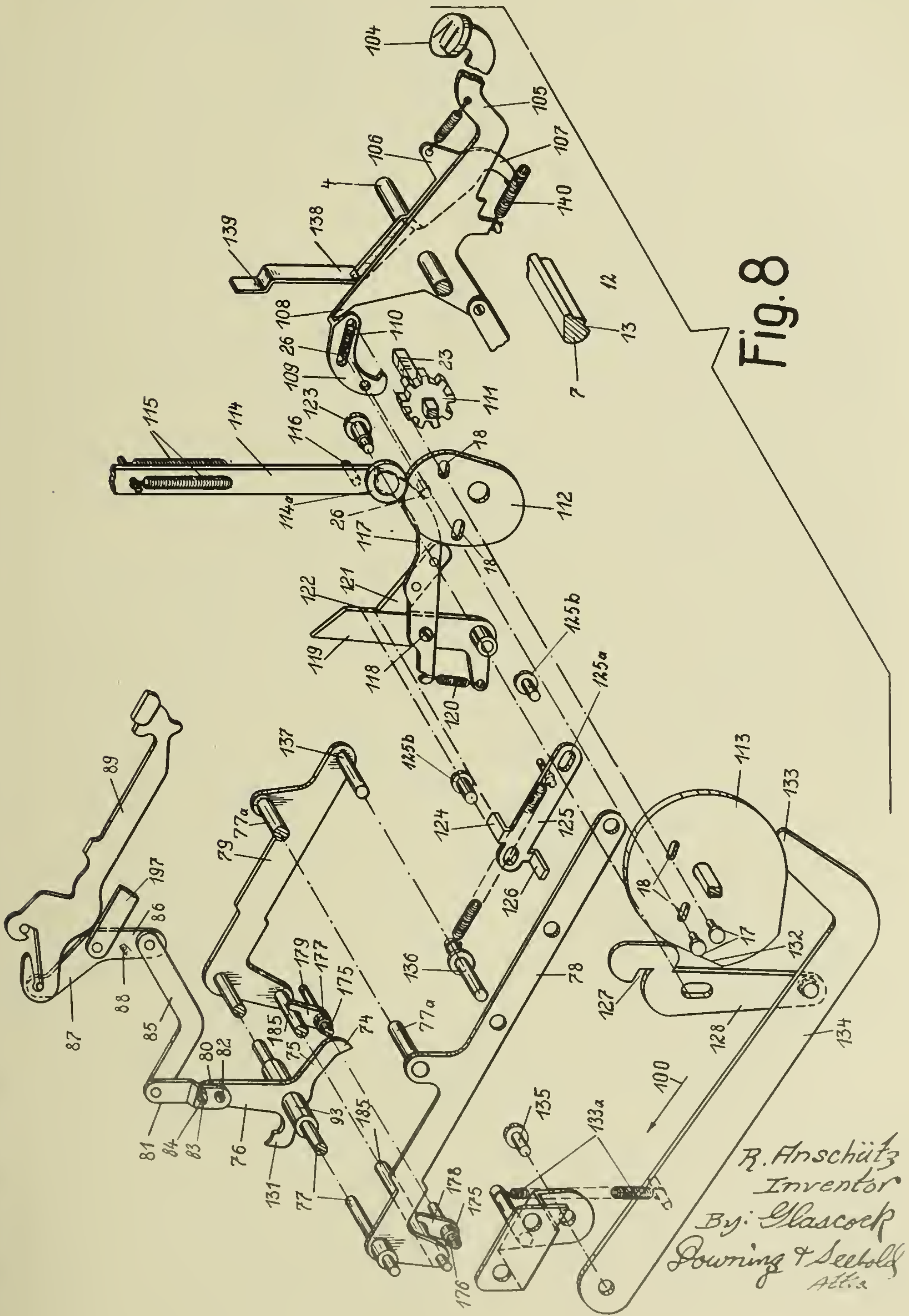

Fig. 8

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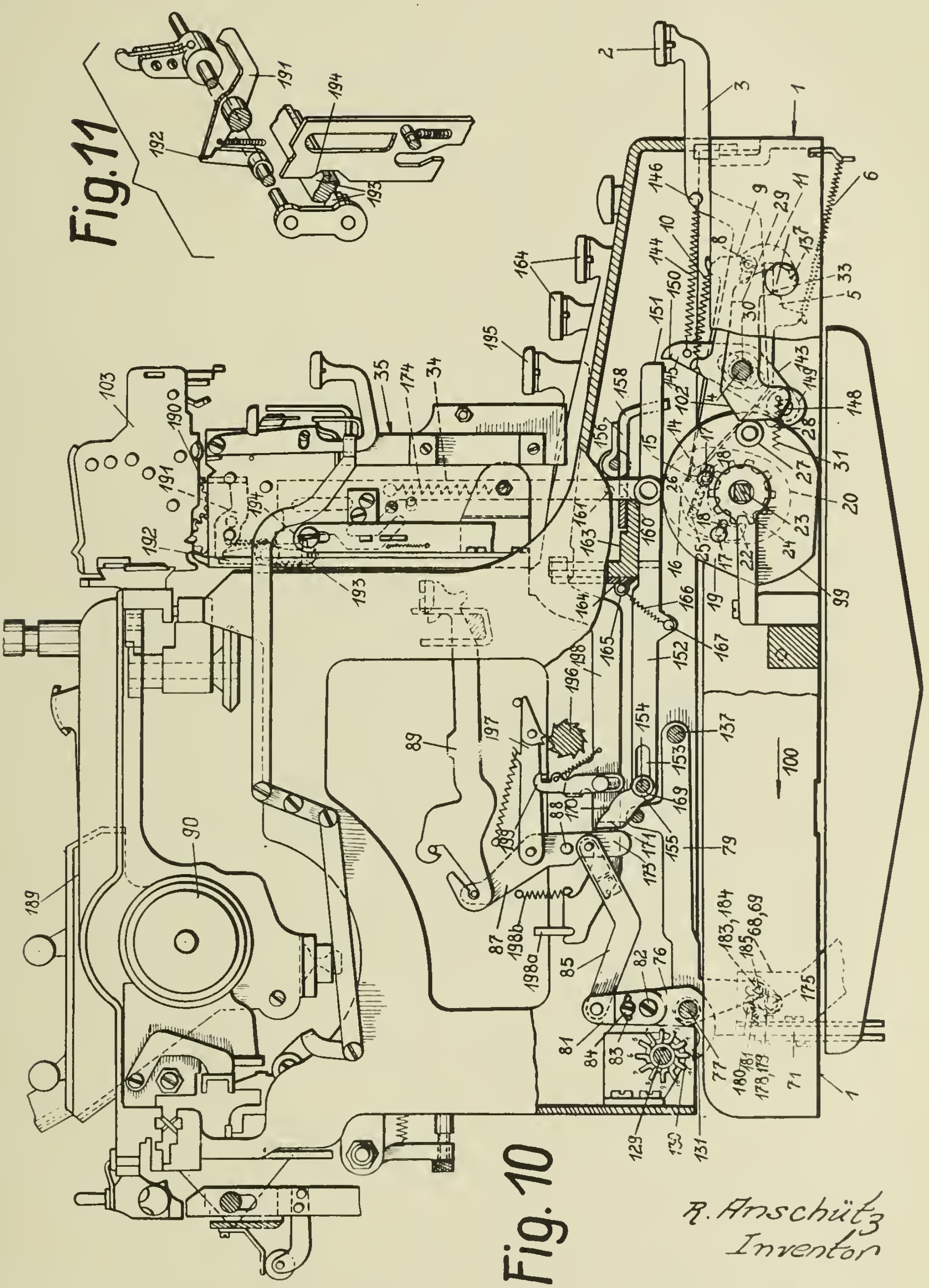

Fig. 11

Fig. 10

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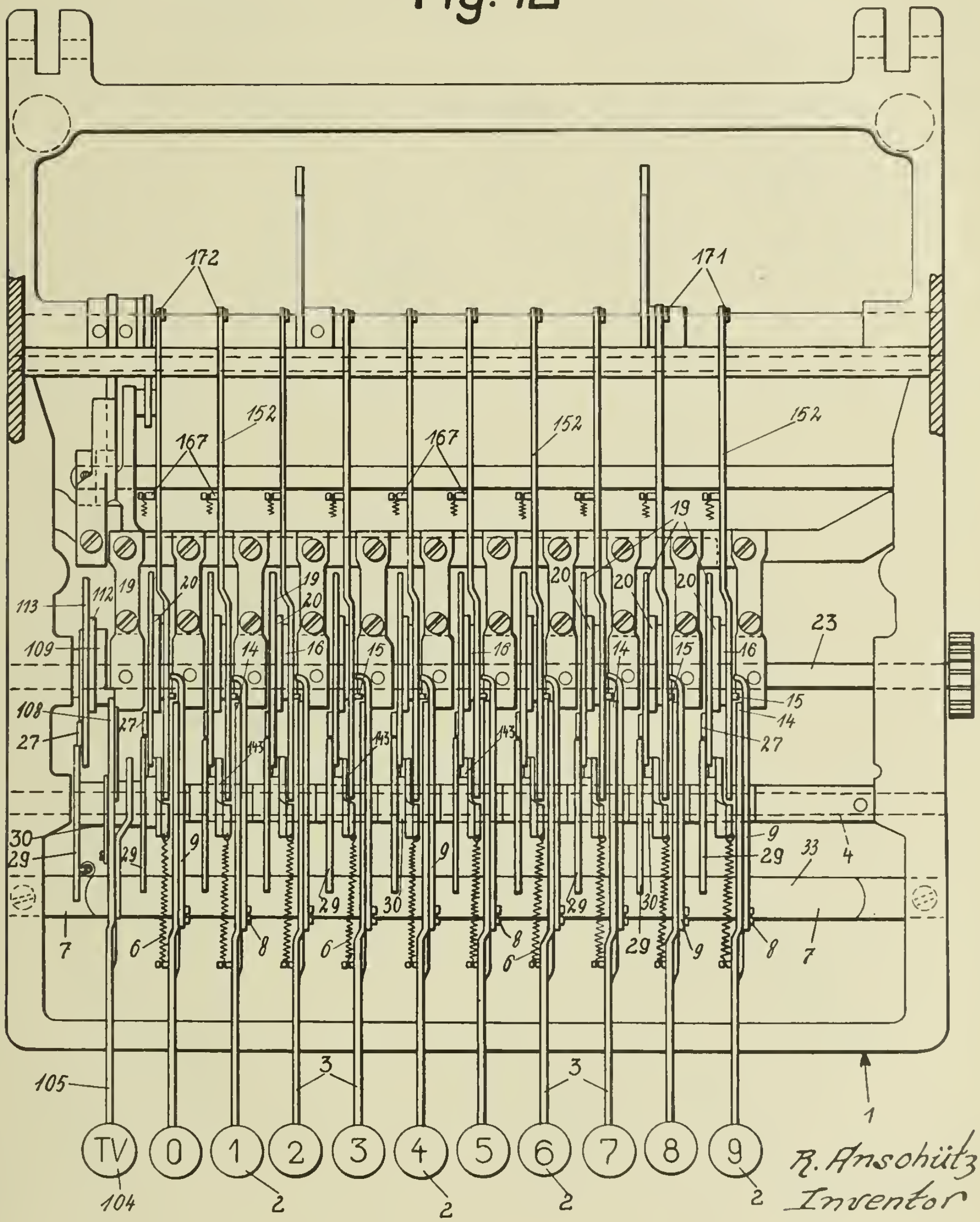
9 Sheets-Sheet 8

Fig. 12



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9 Sheets-Sheet 9

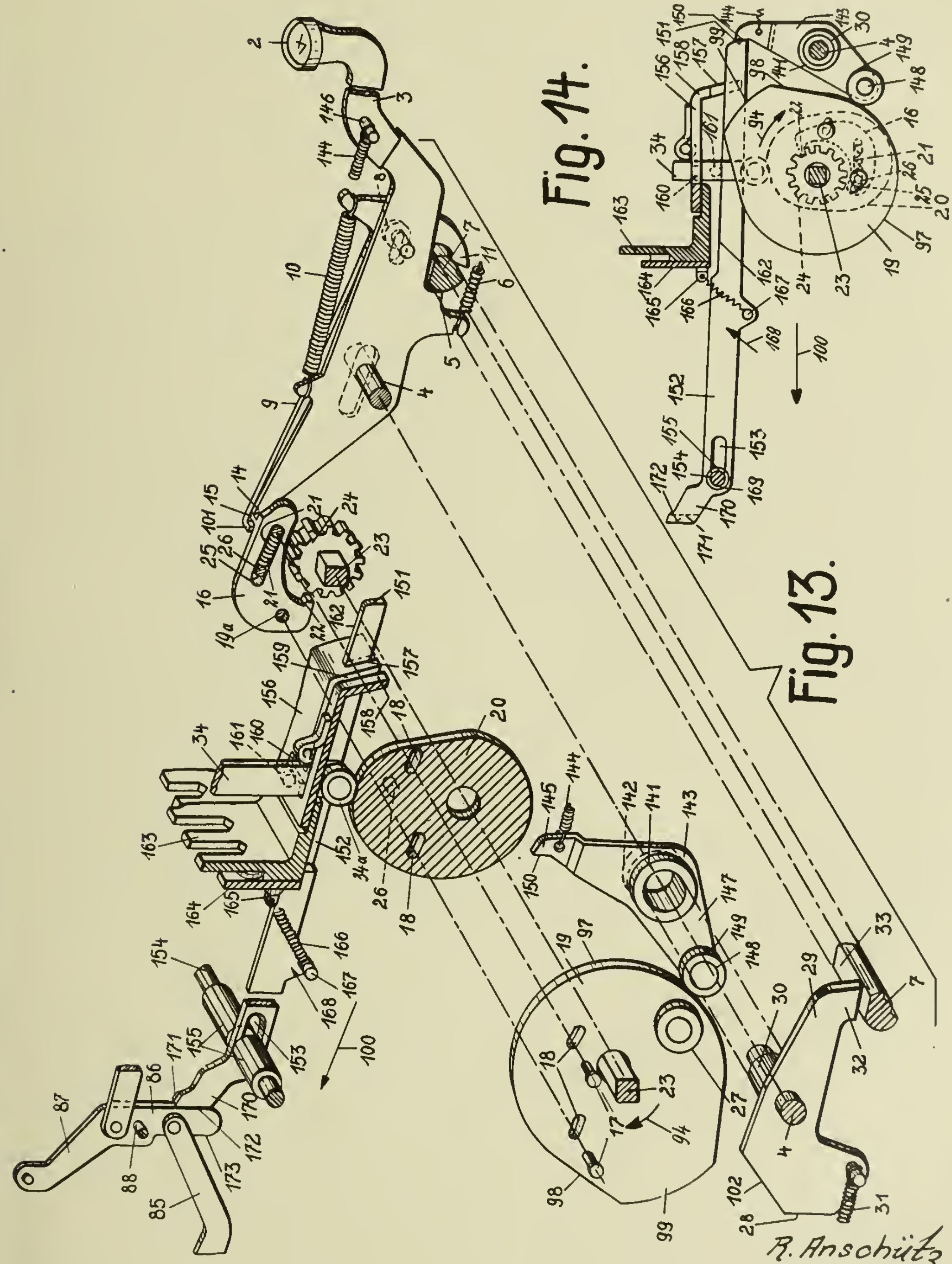

Fig. 14.

Fig. 13.

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Published May 25, 1943

Serial No. 242,072

ALIEN PROPERTY CUSTODIAN

SUSPENSION DEVICES

Maurice François Alexandre Julien, Paris, France; vested in the Alien Property Custodian

Application filed November 23, 1938

This invention relates to the suspension of aeroplane engines and other members on supports subjected to reciprocating movements and more particularly the wings.

Resilient suspensions have already been employed for engines and more particularly for the engines of aeroplanes for the purpose of protecting their frames from the vibrations due to the irregularities of the torque of the said engines.

It has also been proposed (French Patent No. 798,631 of the 28th November, 1935) to construct resilient elements giving also a radial elasticity so that if, for example, the engine has a dynamic want of balance in its rotary movement the frame is automatically protected from the vibrations due to this dynamic want of balance, provided that the resilient elements are suitably calculated.

The present invention envisages the case in which the frame of the engine itself cannot be considered as fixed but is on the contrary rigid with a body which has certain reciprocating movements damped or maintained.

The presence of the engine provided with its suspension then modifies the movements of the body in question in a complex manner by its reactions and it is desirable in such a case to determine the suspension while taking into account not only the vibrations of the engine which must be prevented from being transmitted to the body but also the characteristic movements of the body which it is necessary to avoid making self-maintained and which must be even more damped if possible.

To attain these results the invention proposes to employ a suspension system having torsional elasticity and also radial elasticity, characterised in that the radial elasticity is not the same in the various radial directions and that it is adjusted at least in the most important radial direction (generally the vertical direction) under quite definite conditions, which will be indicated below.

In addition to this definite elasticity it is again proposed according to the invention to introduce suitably proportioned damping means in order to damp the vibrations of the engine relatively to the body which supports it.

An important particular application of the invention is that of an engine mounted on a wing capable of entering into flexion torsion vibrations for example.

It is known that in certain cases these vibrations are self-maintained by the aerodynamic forces. If there are more degrees of freedom (wing with aileron for example) the possible cases of vibrations are still more frequent. These vibrations naturally present great dangers and it is of the highest importance to make the engine and its suspension contribute towards damping them.

Under these conditions the engine only takes part through its mass and all the other masses attached to the wing, such as the landing gear for example, can advantageously be mounted according to the same principles. In such a case the torsional elasticity no longer takes any part and the invention consists solely in a suspension to the supporting mass with an elasticity in the vertical direction, that is to say the characteristic vibrations of the support, accompanied by damping, and such that it allows the maximum damping effect according to the principles which will be explained below.

In a general manner it can be said that the invention is characterised by the fact of mounting in absorbers of vibrations the masses which are necessarily fixed to the wing proper and which do not take part in the wing profile for creating the lift.

The effects of a mass supported resiliently and with viscous damping on the vibrations of an aeroplane wing can be expressed in figures as follows—

Let M_1 be the value of the suspended mass. If ω_1 is the pulsation of resonance of the said mass on its resilient support of the point of suspension fixed in space and if the movement of the said mass is effected with a coefficient of damping $M_1\,\omega_1\,\epsilon$ so that the equation of this movement is:

$$M_1\omega^2_1 z+2M_1\omega_1\frac{dz}{dt}+M_1\frac{d2z}{d_{t2}}=0 \qquad (1)$$

it is found that at each pulsation ω everything happens as regards the wing as if there had been fixed to the point of suspension a mass m rigidly connected to it such that

$$m=M_1\frac{1-\left(\frac{\omega}{\omega_1}\right)^2+4\epsilon^2\left(\frac{\omega}{\omega_1}\right)^2}{\left(1-\left(\frac{\omega}{\omega_1}\right)^2\right)^2+4\epsilon^2\left(\frac{\omega}{\omega_1}\right)^2} \qquad (2)$$

and as if, on the other hand, there had been attached between the same ordinate point z_1 of the vibrating wing and a point fixed in space a viscous damper creating the damping force

$$F=2M_1\omega_1\epsilon\frac{\left(\frac{\omega}{\omega_1}\right)^4}{\left(1-\left(\frac{\omega}{\omega_1}\right)^2\right)^2+4\epsilon^2\left(\frac{\omega}{\omega_1}\right)^2}\frac{dz_1}{dt}$$

If it is desired to study in detail the effects of

the said mass m added to the wing and of the said damping force, it is naturally necessary to observe the repercussions which they involve on the movements of flexion and torsion of the wing.

The effect of the mass m is to modify also in a rather important manner the principal coefficients of inertia in the equations of their movement, to modify much more the terms of coupling by inertia which can even change sign. The effect of the force F is to add everywhere, at all the degrees of freedom of the deformable wing a proportional damping independent of the speed of the aeroplane and which can compensate incompletely or superabundantly the negative damper of aerodynamic origin due to the effects of torsion. In the case in which the compensation is superabundant the placing of the wing in self-vibration starting from a certain critical speed becomes impossible.

It must now be explained how the factors vary with the pulsation ω.

Figure 1 shows the variations of the ratio m/M_1 as a function of ω. This figure shows that at very slow pulsations the mass brought back is equal to M_1. For a certain value of ω in the neighbourhood of but less than ω_1 it passes a maximum which will attain for example the value of 2.2 M_1 if we give to ϵ the value 0.11. For a value of ω scarcely greater than ω_1 m disappears and then changes sign.

It is thus seen that for all the values of ω less than ω_1 the wing has an inertia which is greater than in the absence of mass M and its characteristic frequencies are reduced but that for all greater values of ω everything takes place as if there had been added to the wing a negative mass, that is to say, a kind of resilient return dependent on the frequency, that is to say again that its characteristic frequencies of torsion and flexion will be increased.

This latter circumstance is a priori favourable to the disappearance of the critical speeds for the aeroplane but the most important phenomenon resides in the fact that the distribution of weight relatively to the elastic axis changes very much on account of the positive mass m.

Figure 2 shows in the same way the variations in the coefficient of the force F as a function of ω. From the course of this variation it results that owing to the resonance an extremely large damping force is brought back on the wing for all the frequencies of vibration in the region of $\mp$ 30% around ω_1. All the dampings which result therefrom increase in proportion.

The Applicants have found more particularly that if the suspension of the engine is of the adhering rubber type which has a sufficiently high damping factor ϵ the damping of the flexion and the torsion of the wing resulting from placing the engine in resonance at about $\mp$30%, is about six times greater than the damping of structure of the wing itself supposed of metallic construction: this number six increasing to twenty in the case of the strict resonance $\omega=\omega_1$.

The mathematical theory of the putting into vibration of a wing having flexion-torsion provided with an engine suspended in this way has shown the Applicants that the critical speeds completely disappear owing to the damping.

These explanations having been given the effect of the devices which form part of the invention will be better understood.

Figure 3 shows a suspension according to the invention but in which separate means are not used for ensuring the necessary vertical freedom. It shows the wing **1** in section, the engine **2**, the rubber blocks **3** of the suspension. The invention thus consists in constructing and arranging the said blocks **3** so that the resonance of the engine on the suspension in the up-and-down movement has a pulsation ω_1 comprised between the characteristic pulsation of flexion and the characteristic pulsation of torsion of the wing or less than these two values.

This can quite well be a feature of the invention in view of the fact that in all the suspensions hitherto known the said pulsation ω_1 is very much greater than these values.

The other characteristic frequencies of the engine in the other degrees of freedom will be determined, for example, to satisfy the conditions set forth in the French Patent No. 798,631 already mentioned.

Figure 4 shows a more characteristic arrangement of the invention. The engine **2** is mounted by means of elastic joints **3** calculated according to the conditions of the French Patent No. 798,-631 fixed on a plate or frame **4** which is itself mounted with large freedom for up-and-down movements by means of new elastic supports **3** preferably of the type giving a single degree of axial freedom, on the engine frame proper **6** rigidly fixed to the wing **1**. The elasticity of the flexible devices **5** or similar devices is then chosen so that in the vertical up-and-down movement, taking into account the elasticities in series **3** and **5**, has a resonance ω_1 equal to or greater than the characteristic pulsations of the wings.

Figure 5 shows an improved arrangement in which there is provided between the mounting **4** and the frame **6** real dampers, preferably hydraulic, and giving the desired degree of damping, for example to bring the coefficient ϵ of the equation (1) to the value $\epsilon=0.4$, which corresponds to a weakening in the ratio of 10 to 1 from one amplitude to the next in a movement of free oscillation.

Figure 6 shows an arrangement of the same order in which there is an engine fuselage **8** comprising engine, cover, fuselage proper covering a retractible gear etc. and, if necessary, tanks, which is suspended according to the principles of the invention on the resilient supports **5** and **5'** working in parallel with the hydraulic damper **7** actuated by the relative movements of the assembly **8** in relation to the wing **1**.

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PUBLISHED

MAY 25, 1943.

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M. F. A. JULIEN

SUSPENSION DEVICES

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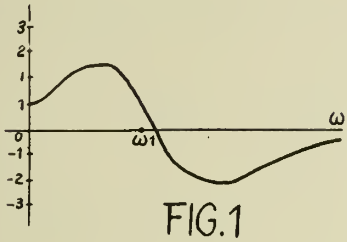

FIG.1

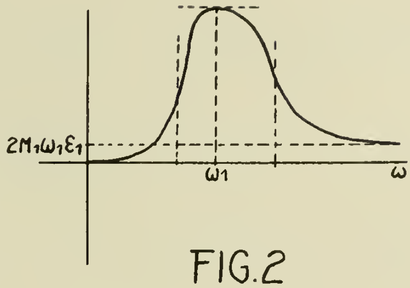

FIG.2

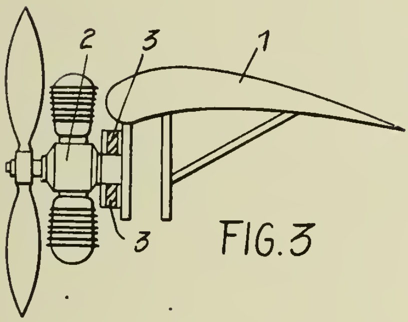

FIG.3

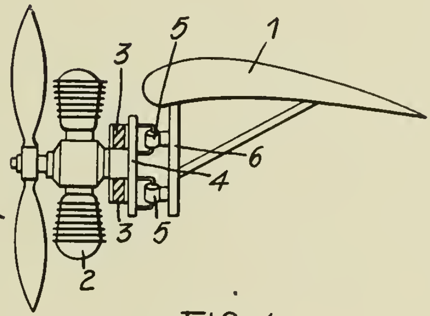

FIG.4

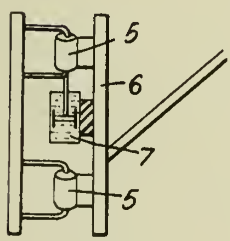

FIG.5

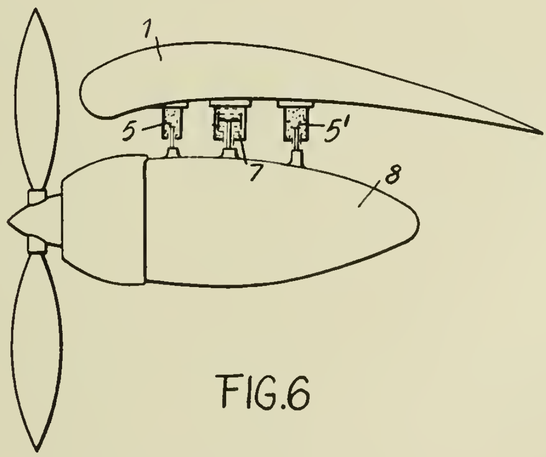

FIG.6

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ALIEN PROPERTY CUSTODIAN

FLUORESCENT SCREENS

Josef Heinrich Hartmann, Rudolstadt, Germany; vested in the Alien Property Custodian

Application filed November 26. 1938

This invention relates to screens which fluoresce when substituted to the action of certain rays.

Fluorescent screens known in prior art are provided with filters which prevent certain portions of the daylight spectrum or of similar artificial illumination from reaching the fluorescent layer of the screen. The purpose of this filter is to prevent those rays which detrimentally affect the fluorescent layer, namely, which cause it to change its color or cause it to phosphoresce, from reaching the fluorescent layer. Filters of this type should be of such color or so constructed that they are transparent for the light emitted by the fluorescent screen, and that they prevent all light which detrimentally affects the fluorescent layer from reaching it.

The drawback of such filters is that it is necessary to provide a separate filter for each fluorescent material and to carry out experiments in order to determine the most advantageous type of filter.

An object of this invention is the provision of a filter of the same consistency, which may be used for fluorescent screens having different fluorescent materials.

Other objects of the present invention will be apparent in the course of the following specification.

The present invention is based on the discovery that in many instances it suffices to cover a fluorescent screen with a filter which completely absorbs all the ultra violet rays of the spectral range and which transmits all the visible rays of light. A filter of this type appears transparent to the eye and has the advantage that it may be used for screens emitting a different fluorescent light, so that a single filter can be employed for different fluorescent layers. Consequently, it is not necessary to adjust the coloring or the type of the filter to the specific fluorescent layer employed in each individual case.

The objects of the present invention may be realized through the provision of a filter consisting of an organic substance into which is embedded an absorbent for ultra violet light. The filter may be very thin and have a thickness of about .01 mm.

Any absorbent for ultra violet rays may be used for the purposes of the present invention. It is advisable to employ substances which, even when used in small amounts, absorb ultra violet rays, particularly the long-wave part of the ultra violet ray spectrum. For example, it is possible to use beta-umbelliferrone acetic acid, which has the faculty of absorbing ultra violet rays of light to such an extent that a layer of acetyl cellulose which is 0.01 mm. thick and a square centimeter of which contains 0.5 mg. of this acid, serves as adequate protecting means for preventing all the detrimental components of daylight from reaching a fluorescent layer containing, for example, zinc sulphide.

A filter of this type is transparent and may be used in connection with layers emitting different fluorescent rays, including fluorescent layers which have zinc sulphides and zinc cadmium sulphides as their active components.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawing showing by way of example a preferred embodiment of the inventive idea.

The drawing shows a fluorescent screen in side elevation.

The screen shown in the drawing comprises a base 1, which may consist of cardboard, rubber, wood, artificial resins, or any other suitable substances. The base 1 carries a fluorescent layer 2, which consists of a fluorescent substance and a binding substance, with the addition of a softening agent in certain instances. The fluorescent substance may consist of zinc sulphide, zinc cadmium sulphide, or the like.

The fluorescent layer is covered by a filter 3 which has the faculty of absorbing at least the major portion of ultra violet rays. The filter 3 may consist of a thin skin of acetyl cellulose having the thickness of .01 mm. One sq. cm. of this skin may contain 0.5 mg. of beta-umbelliferrone acetic acid.

These filters which cover fluorescent screens may be employed in connection with the lead glass used for the absorption of X-rays. Furthermore, filters of this type may be used in combination with strengthening foils, Braun tubes, wall coatings, and the like.

Instead of using a separate light filter, the substance which absorbs ultra violet rays may be added to the binding substance constituting a part of a fluorescent layer.

The advantages of a filter of the described type which contains absorbing means for ultra violet rays may be illustrated by means of the following simple experiment:

A substance which acts as an absorbent for ultra violet rays is imbedded in small quantity in a thin layer of acetyl cellulose. Then a fluorescent screen is covered with this acetyl cellu-

lose filter and is subjected to the ultra violet rays of a quartz lamp, which is provided with a black glass filter for absorbing all the visible rays. Then the ultra violet rays of the quartz lamp are absorbed by the described filter, so that the fluorescent screen covered by the filter will not fluoresce and will appear entirely black.

If, however, instead of using a filter constructed in accordance with the principles of the present invention a fluorescent screen were used which contains substances utilized in the prior art, such substances being added to the binding substance of the fluorescent layer or covering the fluorescent layer, the screen will begin to fluoresce under the influence of the ultra violet light of the quartz lamp. This indicates that the protective coating or the binding substance used in prior art are insufficient to protect the fluorescent layer from the effect of all the ultra violet rays.

It is apparent that the specific illustrations shown above have been given by way of illustration and not by way of limitation, and that the structures above described are subject to wide variation and modification without departing from the scope or intent of the invention, all of which variations and modifications are to be included within the scope of the present invention.

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FLUORESCENT SCREENS

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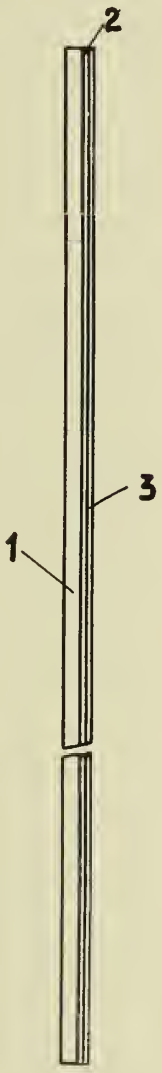

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Published May 25, 1943

Serial No. 242,591

ALIEN PROPERTY CUSTODIAN

CLOSURE FOR CONTAINERS

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Application filed November 26, 1938

This invention relates to improvements in closures for metallic containers of the type commonly employed for the storage and transportation of oil, gasoline and like liquids.

It is a common expedient in the construction of such closures to provide a bushing held in position in a flange at the opening of the container by turning the edge thereof outwardly over the edge of the flange, a screw plug being fitted in the bushing and a seal cap being applied over the closure, but a serious problem arises in providing means for hermetically sealing the bushing with respect to container in an effective and permanent manner.

The object of this invention is to provide an arrangement of gaskets which seals the channel of possible escape of liquid between the container wall and bushing of two separate points and thereby affords double insurance against leakage.

In the accompanying drawing wherein several approved embodiments of the invention are illustrated;

Figure 1 is a sectional view of a closure for containers constructed in accordance with the invention;

Figure 2 is an elevation partly in section showing the seal cap prior to the contraction of the skirt thereof;

Figure 3 is a detailed sectional view illustrating a modification of the invention.

Referring to the drawing in detail, **5** indicates the wall of a metallic drum or container having an opening for filling and discharging the edge of the opening being turned outwardly to form an upstanding flange **6**. At the juncture of the flange and container wall a depression is formed in the latter which constitutes a seat **7** for a flange **8** integral with a bushing **9**. The bore of the bushing is threaded to receive a correspondingly formed plug **10** provided with an external flange **11**.

The body of the bushing **9** is snugly fitted in the flange **6** and the outer end thereof is turned outwardly over the edge of the flange as at **12** thereby firmly drawing the bushing flange **8** within the seat and firmly holding the bushing in position.

In applying and removing the plug **9**, the application of substantial turning force is required and therefore, in order to prevent the bushing from rotating in the seat **7**, the latter is polygonal in shape and the flange **8** is correspondingly formed.

To prevent escape of the liquid contents of the container between the plug **10** and bushing **9**, a gasket **13** is interposed between the plug flange **11** and the bead **12** formed by turning the edge of the bushing. Containers of the type contemplated by this invention are frequently emptied and refilled and each time the plug **10** is screwed in position, the gasket **13** is again effectively compressed and hence a dependable seal is maintained insuring against escape of liquid between the plug and bushing.

A seal cap **14** is applied over the plug **10** and the skirt portion **15** thereof extends below and, as shown in Figure 1, is adapted to be contracted under the bead **12** so as to secure the cap in position in such manner as to insure against undetectable tampering. When the filled container arrives in the hands of an authorized recipient, the cap **14** is removed by tearing it along score lines provided thereon as is well known in the art.

In addition to the possibility of leakage of liquid from the container between the plug **10** and the bushing which, as above stated is dependably sealed by the gasket **13**, a second channel of escape exists between the bushing **9** and the part of the wall of the container constituted by the flange **6**.

To seal this passage, a sealing means **16** in the form of a gasket or sealing compound is provided between the bushing flange **8** and its seat **7**. Due to the application of force, above referred to, necessary to secure and remove the plug **10** during repeated refilling of the container, the engagement of the bushing flange **8** in its seat **7** may become somewhat loosened. Even though this looseness may not be sufficient to prevent retention of the bushing against turning movement within the container, it may impair the effectiveness of the sealing medium **16** between these parts.

Therefore, in accordance with this invention, an additional seal is provided which prevents the escape of liquid which may leak through the loosened sealing means **16**. To this end an additional gasket **17** is interposed between the cap skirt **15** and the upstanding container flange **6**. Incident to the operation of contracting this cap skirt, the gasket **17** is compressed and thereby supplements the sealing means **16** in preventing the escape of liquid between the bushing **9** and the container wall. Thus, the contraction of the cap skirt **15** to a degree sufficient to ensure its retention on the bead of the flange **6**, likewise ensures compression of the gasket **17** to a degree sufficient to form a fluid-tight joint. Accord-

ingly, at each filling of the container a new seal cap replaces the one previously mutilated and removed and a fresh seal preventing leakage is provided by the contraction of the cap skirt and the consequent compression of the gasket 17.

According to one embodiment of the invention, the gasket 17 may be applied about the container flange 6 under the bead 12 by which it is held in position. Rubber cork asbestos or any other suitable material may be employed for making the gasket and during contraction of the cap skirt from its original shape shown in Figure 2 to that shown in Figure 1, the gasket is compressed. With the gasket in this position, it is not damaged during the forcible removal of the cap and may therefore be used repeatedly during numerous refilling operations.

In the modification shown in Figure 3 the gasket 17 is replaced by a gasket 18 inserted inside of the cap skirt and frictionally held in position therein until such time when the cap is contracted upon the container. The gasket is preferably formed of inexpensive material because during the removal of the seal cap it is frequently destroyed but to improve its sealing quality, the gasket is formed of substantially the same width as the length of the skirt 15. Thus, during the contraction of the skirt, the gasket is compressed at two points on the inner surface of the skirt, first at the place where it contacts the bead 12 and, second, at the place where it contacts the flange 6.

ALFONS MAUSER.

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A. MAUSER
CLOSURE FOR CONTAINERS
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Fig. 1.

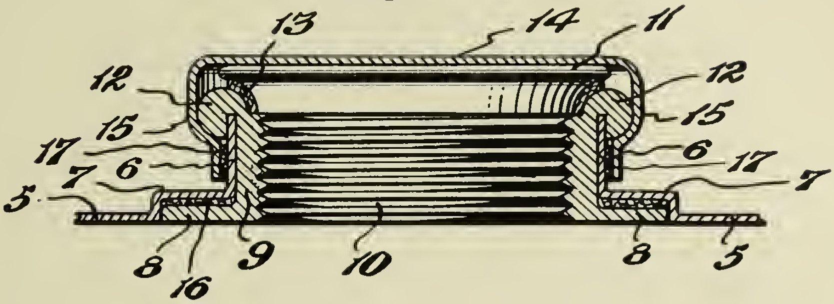


Fig. 2.

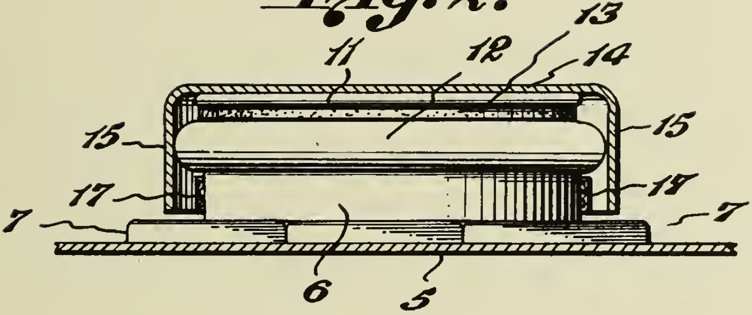
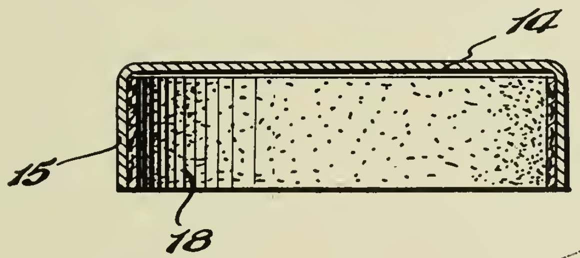


Fig. 3.



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ALIEN PROPERTY CUSTODIAN

AXLE GUIDING ARRANGEMENT FOR RIGID AXLES, SUPPORTED BY SPRINGS WHICH ARE FREELY YIELDABLE UNDER TRANSVERSE FORCES

Max Wagner and Walter Laukhuff, Stuttgart, Germany; vested in the Alien Property Custodian

Application filed December 6, 1938

This invention relates to an axle guiding arrangement for rigid axles supported by springs which are freely yieldable under transverse forces. Such springs are—in contradistinction to leaf type springs—e. g. so-called ring springs (consisting of separate spring rings telescopically fitted one in the other), rubber pads, hydraulic and pneumatic cushions or the like, preferably helical springs and more especially unguided helical springs. This because helical springs show—apart from the drawback which is overcome by the invention—special advantages. The invention is specially adapted for motor vehicles and has for its object to effect a kinetically perfect guiding of such axles which are suitable of reliably taking up even large forces acting between the axle and chassis and which are not absorbed by the springs and to ensure a good road-holding.

The invention consists substantially in that one or more vehicle axles are guided against lateral deflection relatively to the frame by one or several pairs of toggle lever-like links arranged in series. Preferably the rear axle is guided according to the invention and the front axle is constructed as independent parallel guiding of the wheels. Shearing forces and twisting moments (especially driving and braking moments) of at least one axle are preferably taken up by a torsion bracing, provision being made that the vehicle axle can swing about a longitudinal axis extending in the direction of travel. For this purpose at least one of the three joints by which each pair of the toggle lever-like, series arranged guide links is connected together and to the chassis or to the vehicle axle is constructed as a joint movable in all directions, preferably the joint connecting the two guide links, for example as a ball joint, whereas the other joints preferably hinge joints cnly allow a swinging movement about a transverse axis. Preferably only a single pair of links is provided for guiding the vehicle axle, the joint movable in all directions being arranged in the central longitudinal plane of the vehicle.

Contrary to the spring suspension with blade springs (leaf type springs) the axle is guided and resiliently cushioned according to the invention in such a manner that the springs exclusively serve for the cushioning of the axle in vertical direction and are completely relieved from lateral forces, whereas the guiding of the axle and absorption of the lateral forces are effected exclusively by the hingedly interconnected links. This results in a free working of the axle relatively to the chassis and in an advantageous, adaptable spring suspension which can be easily constructed in such a manner that it immediately responds without any friction even in the case of small shocks and obstacles.

The advantages of this spring suspension can be further improved if with driven axles the axle gear is arranged on the chassis with the result that the masses to be cushioned are reduced and the cushioning is made still softer and more adaptable.

Another advantage of the invention is, that the ball joint allowing the swinging movement of the axle is located between the two links. On this account the lateral forces acting on the axle, which are transmitted by the ball joint, cause smaller stresses in the hinge joints of the links, because the arm of lever with which these lateral forces subject the links and bearing points of the links to bending and pressure stresses, corresponds at the most to the length of one link.

By the forked construction of the links they can also be mounted in an advantageous manner on the chassis and on the axle respectively at both sides of an axle gear mounted on the chassis (e. g. by an extension on the gear) in that their forked arms straddle the axle gear and its fixation eye so that the space required by the links is reduced to a minimum. This advantage is particularly desirable when the hinge points of the two links are located approximately one above the other on the chassis and on the axle, whereas the joint connecting the links, (preferably an universal joint), is located towards the end of the vehicle, so that the two links, seen from the side, form a rearwardly directed V.

Moreover the invention relates to a practical arrangement and construction of the axle guide formed by the guide links or the torsion bracing.

In the case of a chassis composed of longitudinal and transverse girders and if helical springs are used, a preferred form of embodiment of the invention consists in that each helical spring bears from below against a longitudinal girder of the chassis at its junction with a transverse girder or near this point and the corresponding shock absorber is arranged on a longitudinal girder of the chassis at its junction with another transverse girder of the chassis or near this junction. Preferably the two mentioned transverse girders are on different sides of the axle.

Helical springs and shock absorbers are preferably arranged on opposite sides of the wheel axle, for example of a swing semi-axle or of a rigid axle, the helical spring preferably bearing with its lower end against the torsion stay extended beyond the extension of its axle to ap-

proximately the point of intersection of the longitudinal girder with the transverse girder.

The invention possesses the advantage of a particularly favourable absorption of the forces, as both the spring forces and also the shock absorber forces are transmitted to such points of the longitudinal girder of the chassis which, owing to the bracing by the transverse girders are particularly suitable for this purpose. The chassis is thus subjected to torsional and bending stresses to a minimum extent.

Furthermore the invention results in a particularly great space-saving arrangement, as the spring and shock absorber fit under the chassis girders and both ends of the axle in a particularly advantageous manner.

Only a single helical spring of particularly large diameter is preferably provided for each side of the vehicle. Thus the structural arrangement is yet more favourable and at the same time a particularly elastic and gentle spring suspension is attained.

A hydraulic shock absorber is preferably used which during the upward movement of the axle exerts no or very little damping effect but during the downward movement and also possibly in the case of relatively large deflections exerts an intensified damping effect.

In the accompanying drawings,

Figs. 1 and 2 show diagrammatic views of a form of construction of the axle guide according to the invention in vertical section and plan view, one pair of guide links being provided on each side of the vehicle,

Figs. 3 and 4 show also in vertical section and plan view and in greater constructional detail another form of construction according to the invention in which only a single middle pair of guide links is provided, and finally

Fig. 5 is an illustration on a larger scale of both guide links which for the sake of clarity are shown in the same plane.

Fig. 6 shows the rear part of a vehicle chassis composed of longitudinal and transverse girders with the special arrangement of the helical springs and of the shock absorbers in side elevation partly in section on line X—Y of Fig. 7,

Fig. 7 is a top plan view of Fig. 6 in which portions of the chassis are cut away for the sake of clearness.

In Figs. 1 and 2 *a* designates the chassis, *b* the rear wheels, c the rear axle which is spring supported relatively to the frame by, for example, unguided spiral springs *d*. The axle is supported against shearing forces acting in the direction of travel and against twisting moments, especially driving and braking moments, in known manner by a triangular bracing formed by two stays *e*, which bracing is hingedly connected to the chassis—preferably by a ball joint *f*—and forms with the axle c a rigid triangular system.

As the springs *d* cannot take up lateral forces, two pairs of links each comprising two toggle lever-like, series arranged links *g* and *h* are provided for guiding the axle against lateral displacement, the link *g* being connected by a joint *i* to the axle *c* and by a joint *k* to the other link *h* which in turn is connected to the chassis by a joint *l*. The two links form an angle α which when the axle is in its normal position is less than 90° and which becomes smaller when the axle swings upwards and larger (for example more than 90°) when it swings downwards.

If the joints *i*, *k*, *l* are constructed as hinge joints in such a manner that they allow a swinging movement of the hingedly connected parts only about a transverse axis of the vehicle, the vehicle axis c—provided the links *g* and *h* are sufficiently rigid—cannot swing about a longitudinal axis extending in the direction of travel. By employing rotary elastic links *g*, *h* such a swinging movement of the axis relatively to the frame can however be attained to a greater or lesser extent. It can also be assisted by constructing one of the joints *i*, *k*, *l* as a ball joint or in some other way as a joint movable in several or all directions, for example by interposing rubber.

The form of construction illustrated in Figs. 3 to 5 is particularly practical and particularly suitable for heavy stressing. The corresponding parts are designated as in Figs. 1 and 2. Contrary to the form of construction according to Figs. 1 and 2 only a single middle pair of links *g*, *h* is provided, the upper link *h* and the rear part of the chassis being indicated in dot-dash lines in Fig. 4. The links are triangular—or forked or V-shaped as shown particularly in Fig. 5, the link *g* being connected to the axle by two pin or hinge joints *i* arranged on the ends of the fork arms, and the link *h* to the chassis by correspondingly arranged pin or hinge joints *l*. The two links are connected by a ball joint *k* arranged in the longitudinal central plane of the vehicle. The ball *k* is arranged on a pin *m* inserted on to the link *g* and secured by a nut, whereas the ball cup is bolted in the form of a two-part bearing *n* on one end of the link *h* provided with a cross brace *o*. The joints *i*—*i*—*k* and *l*—*l*—*k* each form a rigid triangle with the result that the axle c is secured in a reliable manner against lateral displacement relatively to the chassis and even large forces can be transmitted perfectly. Yet, for example rubber pads might be interposed in the joints to effect a noise damping and a certain elastic taking up of lateral shocks.

Owing to the ball joints *f* and *k* arranged in the longitudinal central plane of the vehicle the vehicle axle can swing relatively to the chassis about the longitudinal axis A—B so that even one-sided stresses by which one or other wheel is lifted are gently damped. Instead of the joint *k*, the joint *i* or *l* may be constructed as ball joint or as joint movable in several or all directions and allowing the vehicle axle to swing about a longitudinal axis. If the joint *l* is correspondingly constructed the advantage is derived that the longitudinal axis A—B which would now extend through the joint *l* is correspondingly higher and above the middle of the wheels and consequently the stability of the vehicle in respect to transverse oscillations and transverse inclinations is increased to a corresponding extent.

The axle c is constructed as a tubular axle and rearwardly bent in the middle in order to pass around the differential gear *s* suspended for example elastically at three points *r* on the cross members *p* and *q* of the chassis. The stays *e* may also be tubular or box-shaped. As can be seen they extend beyond the axle c, the axle *c* passing through and welded to them to form a rigid unit. The ends of the stays projecting beyond the axle serve as lower support for the unguided helical springs *d* which are secured to the end of the stays or to the chassis by fastening elements.

The vehicle is driven by an engine, for example arranged at the front of the vehicle, through the intermediary of the driving shaft *t*, the differential gear *s* and the cardan shafts *u*. The front

wheels (not shown) are preferably guided parallel or substantially parallel independent the one of the other, for which links, transverse springs, cylindrical guides or other guiding means may be used.

Figs. 6 and 7:

The chassis comprises longitudinal girders A_1 preferably of oval cross-section and preferably tubular transverse girders B_1, C and D_1.

The rear wheels E are driven by cardan shafts F which in turn obtain their drive from the cardan shaft G through the axle gear H which is secured on at least one of the transverse girders or for example at two points on the transverse girder B_1 and at one point on the transverse girder C.

The rear wheels E are connected by a rigid axle I which is tubular and bent rearwardly around the axle gear, preferably towards the side of said girder, one of the links of the frame of links being hingedly mounted on this girder.

For taking up the shearing forces tubular or box-shaped torsion stays K are provided which, in the example illustrated, are rigidly connected to the axle in that they are led therethrough and welded thereto. The stays K, only one of which is shown in the drawings, form with the axle I for example A_1 triangular bracing which at its front end can be supported on the chassis in known manner by a ball joint. A helical spring M bears downwards on the end L of the stay K projecting beyond the axle I, the lowermost coil of the helical spring wound to a smaller diameter being clamped in known manner by a fastener element N. The uppermost coil of the helical spring is similarly connected by a fastener element O to the longitudinal girder A_1 below its junction with the transverse girder C.

For taking up the lateral forces between the axle and chassis, which cannot be taken up by the helical spring, again a toggle-lever-like link guiding arrangement consisting of forked links P and Q is provided, the link P being connected to the transverse girder C and the link Q to the axle I by hinge joints and the two links P and Q being connected one to the other by means of a ball joint R.

The shock absorption is effected by a hydraulic shock absorber S which is fixed on the inner side of the longitudinal girder A_1 directly underneath the transverse girder B_1 and whose lever T is connected to an arm V of the axle I by means of a link U provided with ball joints.

As can be seen the helical spring M is arranged under the point of intersection of the longitudinal girder A_1 with the transverse girder C and the shock absorber S approximately at the point of intersection of the longitudinal girder A_1 with the transverse girder B_1 in such a manner that the helical spring and shock absorber are on opposite sides of the axle I or the cardan shaft F. The helical spring M is of particularly large diameter so that a soft elastic suspension is obtained, and is arranged on the extension L of the stay K in such a manner that it is behind the arcuate bend of the axle I.

As may be seen a preferred form of embodiment consists in that the thrust stays supporting the axle against the chassis in the direction of the travel and the axle are constructed as hollow elements and rigidly connected at the points of intersection so that a triangular thrust bracing of hollow elements is formed.

The stays then may be of box-shaped cross-section and the axle is tubular and extends through the thrust stays and is welded thereto.

Furthermore the thrust stays are extended beyond the axle and the extensions serve for supporting the helical springs resiliently supporting the axle against the frame.

Finally according to a preferred form of embodiment the arrangement comprises a rigid axle, means for supporting the axle relatively to the frame transversely to the direction of travel of the vehicle, thrust stays for supporting the axle in the direction of travel, helical springs for supporting the axle relatively to the chassis in substantially vertical direction, the springs bearing directly against the thrust stays.

In this case, if the chassis consists of longitudinal and transverse girders the thrust stays may extend beyond the axle and the helical springs are arranged between the axle and the chassis in such a manner that the lower end of each of the springs bears against one of the extensions of the thrust stays and the upper end of each of these springs bears against the longitudinal girder of the chassis at its junction with the transverse girder of the chassis.

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AXLE GUIDING ARRANGEMENT FOR RIGID AXLES, SUPPORTED BY SPRINGS WHICH ARE FREELY YIELDABLE UNDER TRANSVERSE FORCES

Filed Dec. 6, 1938

Serial No. 244,160

2 Sheets-Sheet 1

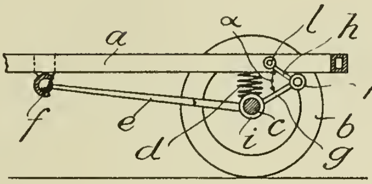

Fig.1.

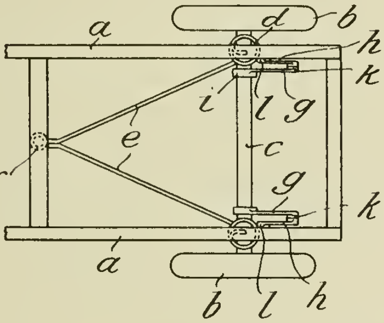

Fig.2.

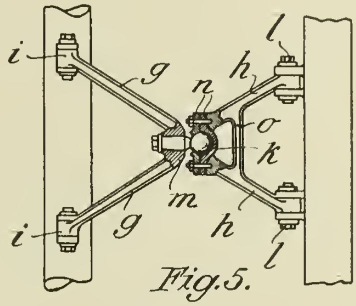

Fig.5.

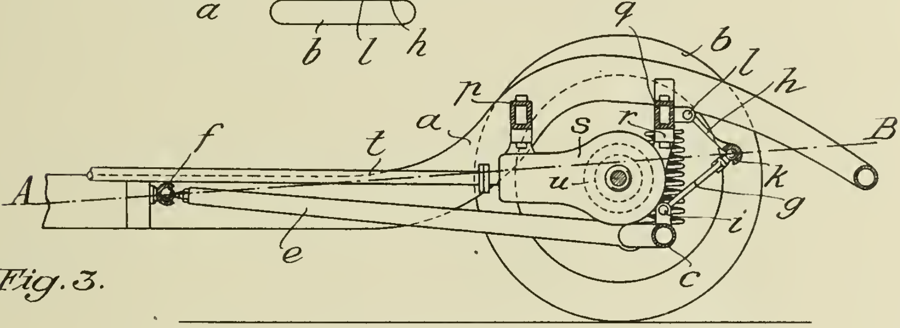

Fig.3.

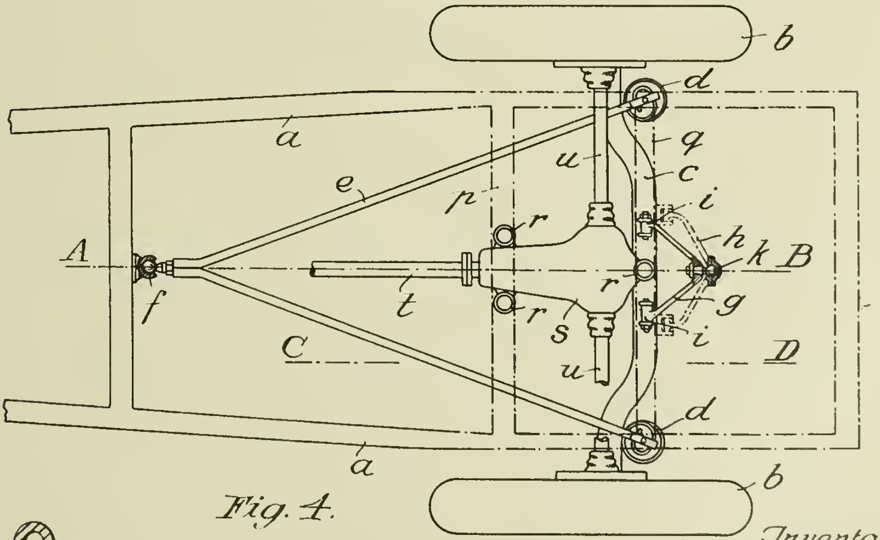

Fig.4.

Fig.4A.

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AXLE GUIDING ARRANGEMENT FOR RIGID AXLES, SUPPORTED BY SPRINGS WHICH ARE FREELY YIELDABLE UNDER TRANSVERSE FORCES

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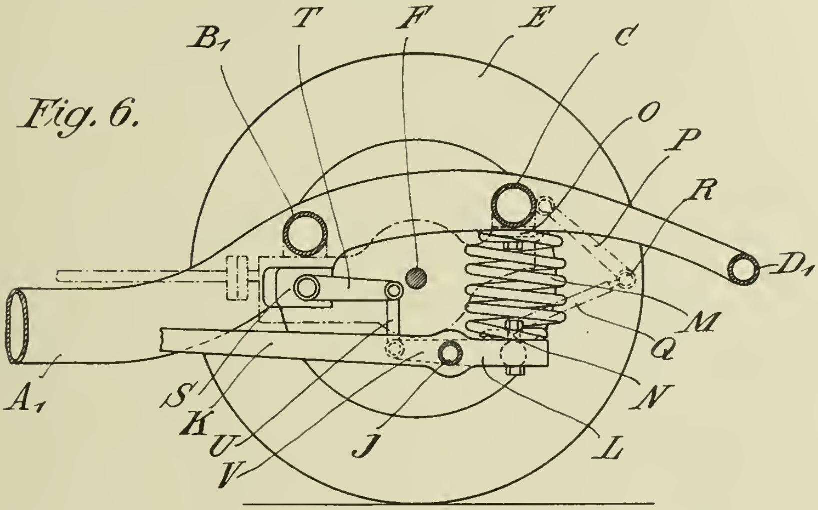
2 Sheets-Sheet 2

Fig. 6.



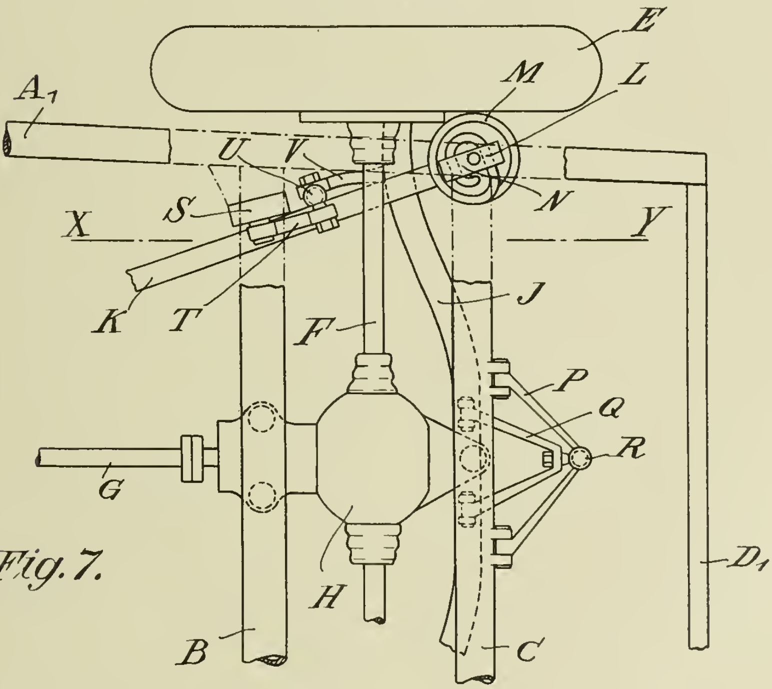


Fig. 7.

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ALIEN PROPERTY CUSTODIAN

DEVICE FOR THE CONTINUOUS DIALYSIS IN COUNTER-CURRENT OF LIQUIDS CONTAINING SUBSTANCES IN A COLLOIDAL STATE

Gerrit Willem van Barneveld Kooy, The Hague, Holland; vested in the Alien Property Custodian

Application filed December 8, 1938

It is known that the caustic soda in the waste lyes of the industry of artificial silk, applying the viscose-process, and in the waste lyes which are formed during the manufacture of such products such as cellophan. woolly products obtained from artificial silk (Zellwolle) and the like can be recovered by dialysis. It is obvious that for this purpose devices, the construction of which resembles that of the so-called frame-filter-presses, can be used. In the filter presses just referred to there are provided on the one side a number of frames arranged in parallel and containing the impure liquid and on the other side a number of frames, also arranged in parallel, receiving the filtrate. The frames are always arranged in such a manner that the frames 1, 3, 5 and so on just as the frames 2, 4, 6 and so on communicate with each other. Between the frames the filter cloth is arranged. The frames receiving the impure liquid are all fed from a common inlet while each of the frames from which the filtrate flows away may have a special outlet, or a common outlet may be provided.

As in a dialyser two liquids are always flowing it was only necessary to provide both groups of frames each with a common inlet and also with a common outlet, while for a filter cloth between the frames membranes were employed. The arrangement was such that the membranes as in the case of the filter cloth of a filter press could be rapidly and easily replaced. As the membranes when building up the press could be clamped between rubber packings arranged on the frames, it was possible to apply membranes comprising sheets of parchment, which are not only cheap but also have a great permeability. Consequently in applying a great dialysing-speed per cm^2 of the membrane-surface a rather small surface is sufficient. As in the industries above mentioned large amounts of waste lyes must be dialysed, a large membrane-surface is necessary; plants with a total active membrane-surface of 1200 M^2 and more are therefore not uncommon. It is obvious that those surfaces will be distributed over as small a number of devices possible; consequently each of them must embody a large number of frames.

In addition to the foregoing the following factor plays an important part. In order to obtain a high efficiency the treated waste lye may not contain more sodium hydroxide than is necessary to prevent the separation at the flocculent state of the impurities, in this case the hemicellulose, which would obstruct the pipes of the devices and the pores of the membranes.

In order to meet those requirements it is necessary to distribute the liquids flowing into the device uniformly over the spaces arranged in parallel and bounded by the membranes. For if more lye is flowing through a certain space than the neighbouring membranes can deal with, the treated lye flowing out contains a high percentage of sodium hydroxide which means a loss. If, however, one space receives too much lye, the other space will receive too little lye; consequently the dialysis will be carried out too intensively and the colloids will be separated at the flocculent state. In this case the disadvantages above-mentioned arise. The same disadvantages arise if the distribution of water is unequal. If the amount of water flowing through a space is too little, the dialysis in the neighbouring spaces may not be carried out in an efficient manner, which means a loss. If this amount of water is too large, the dialysis in the neighboring spaces will be carried out too intensively, hence separation at the flocculent state. If the surface of the membranes is more increased than theoretically corresponds with the amount of lye to be treated, no advantage is obtained, because in this case the undesired separation of the colloids at the flocculent state is still more intensive.

It has been found that in a filter press such a uniform distribution of the liquids over the spaces arranged in parallel does not happen, which may be proved by providing those spaces with special outlet pipes for the filtrate. This uniform distribution of the liquids is not necessary when using a filter press as distinct from a device for the dialysis, in which the uniform distribution plays an important part. Such a uniform distribution could also be obtained with a device for the dialysis for the following reasons:

In a device for the dialysis the spaces arranged in parallel for the liquids which serve as a dialysing means as well as the spaces for the liquids to be dialysed form communicating vessels, which means that at the same level the pressure is the same. As in the liquid to be dialysed, e. g. the pressed lye, which flows from the bottom to the top, the percentage of sodium hydroxide decreases, also the specific weight of this liquid will decrease. If in this case the speed of the liquid in all spaces is not the same, the pressure at the same level will no longer be the same. If the speed in one space is too high, no sufficient dialysis takes place in this space; consequently the pressure in this space is higher than in a communicating space in which a lower speed prevails. Under these circumstances a regulating action

would arise providing for a uniform distribution of the lye over the spaces arranged in parallel. The same action takes place in the spaces in which the water flows from the top to the bottom, this water being converted into pure lye.

It has, however, been found that in practice this regulating action particularly when using devices embodying a large number of spaces, results in nothing. As the inlet of each liquid is situated at the same side as the outlet, the path which must be covered by each particle of the liquid will be longer as it flows through a space situated at a greater distance from the head containing the inlet as well as the outlet for this liquid. The losses of pressure which are caused by the frictional resistance are consequently not the same. The regulating action above-mentioned is consequently in part nullified and the more so as the length of the device is increased and consequently the difference between the paths to be covered becomes larger. For example in using a device of great capacity containing 80 spaces arranged in parallel between the heads in which alternatively 40 spaces serve for the liquid to be dialysed and 40 spaces serve for the dialysing liquid, the path through the first space in a horizontal direction amounts only to a few cm; however, through the last space the way amounts to more than 5 m while the paths in a vertical direction are always the same.

The invention has for its object to remove the detrimental influences exerted by the difference in the losses by friction between the paths which each lead through one of the spaces arranged in parallel by the uniform distribution of the liquid over these spaces.

The device according to the present invention, which, in accordance with the construction of a filter press, contains frames or plates provided with membranes which are arranged in a replaceable manner between a fixed head or one or more movable heads, the spaces bounded by those membranes being arranged in parallel and being alternatively passed in counter-current by the liquid to be dialysed and the dialysing liquid, is characterized by the fact that the outlet for each of the liquid is always arranged at the end of the device opposite to that at which the inlet for this liquid is arranged.

According to this construction the paths which are followed by the liquids have always the same length no matter through which spaces those liquids pass, as the paths which are followed by the liquids in the spaces bounded by the membranes have always the same length. It is true that now the path of inlet which must be covered by a particle of the liquid is longer as the space which must be passed is situated at a greater distance from the head; however, the path of outlet for the particle of the liquid decreases in the same degree; consequently the whole path always has the same length.

With a device constructed according to the invention it is quite immaterial whether both inlets for the two liquids are arranged at one side and both outlets at the other side of the device or whether the inlet for one liquid and the outlet for the other liquid is at one end of the device and the outlet for the first liquid and the inlet for the second liquid at the other end. The main point is that the inlet and the outlet for the same liquid is always arranged at opposite ends of the device. Preferably both inlets for the two liquids are arranged at the same side of the device on the fixed head, on which the controlling means for the inlets are also mounted. In this case the movable head only carries the outlets through which the liquids flow freely away.

As an example of a form of the invention, the device consists of a double filter press with a fixed head in the middle of the press. On both sides of this head 80 spaces separated the one from the other by membranes of parchment are arranged, those spaces being arranged in parallel and being alternatively traversed by the lye to be treated and by water. On both sides of the fixed head movable heads are arranged at both ends of the device. On the centre part four inlets are arranged for the inlet of the lye and of the water. Each of the movable heads has an outlet for the treated lye and an outlet for the pure lye. On each side of the middle part the water flows from the top to the bottom through the frames **2**, **4**, **6** . . . **80** and is converted on its way into pure lye. The impure lye (pressed lye) which flows through the frames **1**, **3**, **5** . . . **79** from the bottom to the top, leaves the device at the upper side of the movable head. In order to prevent the device from emptying itself, the collected pure lye, flowing at the bottom from the movable head, is guided in a upward direction by means of a pipe fixed to the head, this pipe being bent at the upper side.

In order that the invention may be the better understood reference is made to the accompanying drawings in which:

Fig. 1 is a view.

Fig. 2 is a plan view of the device.

The water enters the device at **1** and flows through a pipe into the spaces **5**, **7** and **9** leaving those spaces through a common pipe at **3**. The path which is covered by this liquid in passing the several spaces is always the same. For the path of inlet for this liquid, passing the space **5** is short, however, the path of the outlet is long. The path of the inlet for the liquid passing the space **9** is long, while the path of outlet is short. As the path of inlet increases, the path of outlet decreases and conversely; the total path, however, remain the same, thus yielding the advantages above-mentioned. The explanation given in connection with the water or the pure lye also applies to the impure lye or the waste lye. For the impure lye enters the device at **2** and flows from the pipes as indicated through the spaces **6** and **8**, leaving the device at **4** through the common pipe in the form of waste lye. Also in this case the phenomenon arises that as the length of path of the inlet for the impure lye increases, the length of path of outlet for the liquid in the form of waste lye decreases and conversely. The total length of the path covered by this liquid, however, always remains the same.

The invention is not limited to the application to pressed lyes as described, as it may be applied to all liquids containing substances in a colloidal state.

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DEVICE FOR THE CONTINUOUS DIALYSIS IN COUNTER-CURRENT OF LIQUIDS CONTAINING SUBSTANCES IN A COLLOIDAL STATE

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Fig:1.

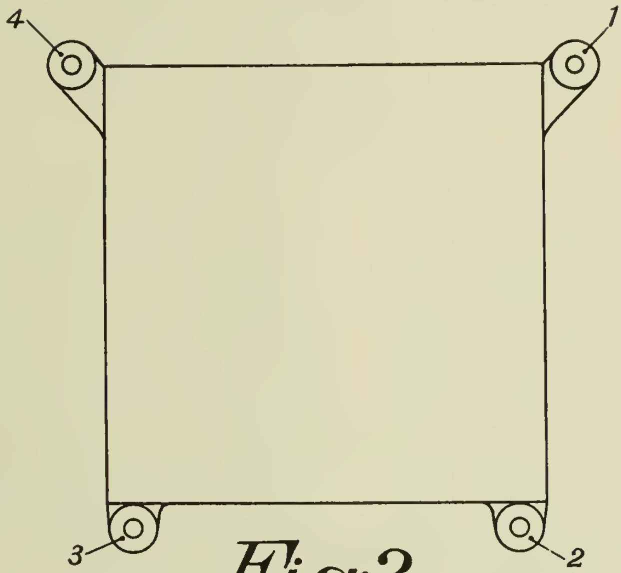
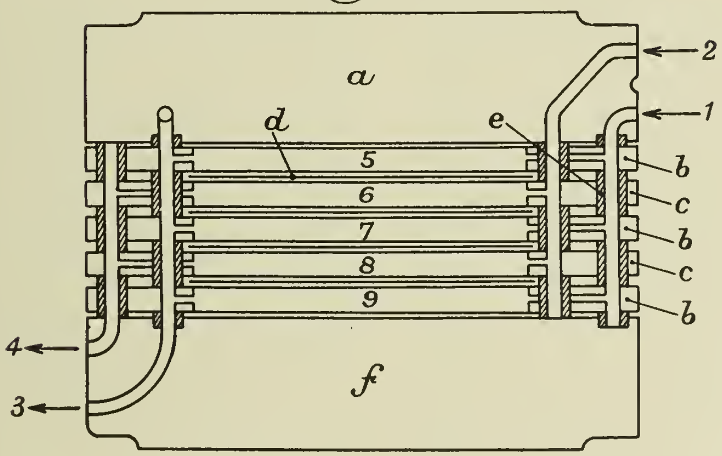


Fig:2.



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INVENTOR

By Otto Munk
his ATT'Y.

Published May 25, 1943 | Serial No. 245,580

ALIEN PROPERTY CUSTODIAN

AEROPLANE SUPPORTING PLANE

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Application filed December 14, 1938

This invention relates to an aeroplane supporting plane with two adjustable parts which in position of rest supplement the wings to form a wing of normal profile, these adjustable parts consisting of an aileron rotatable or rearwardly shiftable or both rotatable and rearwardly shiftable, and of a flap carried by the aileron and positively participating in the adjustment thereof. This flap, when the aileron is in its extreme position of adjustment, can assume a position positively set relative to the under side of the aileron and forming a gap therewith. In the known supporting planes of this type the flap is on the under side of the aileron even in the position of rest. As compared therewith the flap in the supporting plane according to the invention is arranged so that in its position of rest it is on a side other than the under side, for example on the upper or rear side of the aileron and can be swung about the rear edge of the aileron to be brought into the above mentioned extreme position of adjustment. This construction presents the advantage that for adjustment of the flap only relatively small operating means are necessary which do not considerably increase the weight of the aeroplane supporting plane and only give slight inducement to the formation of air resistances and eddy currents. At the same time the whole control mechanism becomes very rigid so that detrimental vibration of individual parts need not be feared.

Several embodiments of the invention are illustrated diagrammatically by way of example in the accompanying drawings, in which:

Fig. 1 shows a portion of a wing in side elevation,

Fig. 2 is a similar view of a second form of construction with the aileron and flap in inoperative position,

Fig. 3 is a similar view to Fig. 2 with the aileron and flap rearwardly displaced,

Fig. 4 is a similar view to Fig. 2 with the aileron and flap rearwardly displaced and swung down into the extreme adjusted position,

Fig. 5 shows the control mechanism in longitudinal section on line **5**—**5** of Fig. 6,

Fig. 6 is a cross-section on line **6**—**6** of Fig. 5,

Figs. 7 to 9 are similar views to Figs. 2 to 4 of a third form of construction,

Figs. 10 to 12 are diagrammatic views illustrating the operation of the aileron and flap,

Figs. 13 and 14 show two additional forms of construction in different adjusted positions,

Fig. 15 shows a detail of Fig. 13 on a larger scale.

In all forms of constructions I designates the wing, II the aileron, III the flap, the aileron II and flap III, when in their inoperative positions, supplement the wing to form a supporting plane of normal profile. Several similarly constructed control mechanisms must always be imagined as arranged side by side perpendicularly to the surface of the drawing.

In the form of construction illustrated in Fig. 1 the flap III is arranged within the profile of the aileron II in a recess in the upper side thereof. A control lever **2**, rotatable about the axle **1** in the wing I, is connected by a link **3** with the nose of the flap III. This flap is supported by two links **4**, **5** which are rotatably mounted in a plate **6** arranged on the under side of the aileron II. The control lever **2** is also connected at an intermediate point of its length to the nose of the aileron II by a link **7**, and this aileron in its inoperative position bears without gap against the wing I and is rotatably mounted on a bottom bracket **9** of the wing I by means of an extension **8**. If the control lever **2** is moved in clockwise direction into the extreme position illustrated in dot-dash lines, the flap III is swung about the trailing edge of the aileron II, and in this position the flap is positively set relatively to the under side of the aileron and a nozzle-like gap is formed between the two parts.

In the form of construction illustrated in Figs. 2 to 6 the flap III is also arranged within the profile of the aileron in a recess on the upper side thereof. The aileron II and the flap III, when in inoperative position (Fig. 2), are in a recess formed in the wing I at a distance from its upper and under side, from which recesses they can be rearwardly shifted into the position shown in Fig. 3. IV is a closing member arranged on the nose of the aileron II at a distance therefrom and closes the mouth of the recess **10** when the aileron II and the flap III are rearwardly shifted into the position illustrated in Fig. 3.

The control (Figs. 5 and 6) consist of two bars **11** of U-section fixed on the wing I with their open sides facing each other, a box-shaped bar **12** located between the bars **11** and having a longitudinal slot in its under side, and an inverted T-bar **13** whose web extends into the box bar through the longitudinal slot. The box bar **12** is longitudinally shiftable between the U-bars **11** and the T-bar **13** in the box bar **12**. The box bar **12** is guided by rollers **14** on the inner walls of the U-bars **11** and the T-bar **13** by rollers **15** on the inner walls of the box bar **12**. The clos-

ing member IV of the aileron II is fixed to the under side of the T-bar 13. The box bar 12 carries on its under side the bearing for a transverse axle 16 about which the nose of the aileron II can oscillate. The aileron II is further connected by a link 17 with the end of the T-bar 13 projecting from the rear of the box bar 12. The movement of the T-bar 13 in rearward direction is limited by an abutment (not shown) arranged on the U-bars 11 in its path or in that of its rollers 18. The T-bar 13 and the box bar 12 are connected by a spring (not shown) which tends to move the T-bar 13 in rearward direction out of the box-bar 12. The front end of the box bar 12 has two racks 18 on its under side meshing with two interconnected spur wheels 20 arranged on a common axle on the wing and adapted to be rotated by a srocket wheel 19 rotatable from the cockpit.

The flap III, as in the construction illustrated in Fig. 1, is carried by two supporting levers 4, 5 which are rotatably mounted on a plate 6 fitted on the under side of the aileron II. At the nose end of the flap is attached one end of a rope which runs over two guide pulleys 22 mounted one on the rear end of the plate 6 and the other on the axle at the lower end of the link 17, and whose other end is secured to the under side of the T-bar 13. A spring between the aileron II and the flap III tends to retain the flap III in the recess in the aileron II.

When the sprocket wheel 19 is rotated, the box bar 12 and the T-bar 13 first move to the rear together until the T-bar or the rollers 15 of the same come into contact with the abutment (not shown). The aileron II, flap III and closing member IV located in the inoperative position (Fig. 2) in the recess 10 are then all together rearwardly shifted into the position shown in Fig. 3, in which the pivot axle 16 of the aileron II is outside the recess 10 and the closing member IV closes the rear mouth of this recess 10. If the sprocket wheel 19 is turned further, while the T-bar 13 remains stationary, the box bar 12 alone continues to move in rearward direction, with the result that the aileron II is shifted beyond the position shown in dot-dash lines in Fig. 4 into the position shown in solid lines in this figure. Thus, a pull is exerted on to the rope 21 which results in the flap III being swung about the trailing edge of the aileron II into the position indicated in solid lines in Fig. 4 against the action of the spring between the flap III and the aileron II.

In the form of construction illustrated in Figs. 7 to 12 the aileron II and flap III are arranged the one behind the other in a recess provided in the under side of the wing.

As in the form of construction illustrated in Figs. 2 to 6 (see particularly Fig. 5) a box-shaped bar 12 movable between the U-bars 11 and a T-bar 13 movable in this box bar 12 are provided. The box bar 12 and the T-bar 13 are also in this form of construction connected by a spring (not shown) which tends to pull the T-bar out of the box bar and the aileron II can swing about a transverse axle 16 whose bearing is mounted on the box bar 12. Moreover, the aileron II is connected to the T-bar 13 by a link 17. The flap III is oscillatable about a transverse axle 23 arranged on the aileron II and connected to a jib 24 (Figs. 8, 9) on the aileron by means of two links 26, 27 connected by a pivot axle 25, (See also Figs. 11 and 12). When the flap III is in its inoperative position, the links 26, 27 assume the position shown in Fig. 11 (folded position) and when the flap III is swung down they assume the spread position shown in Fig. 12. A spring (not shown) is between the jib 24 and the flap II and tends to pull the flap into its inoperative position and to thus return the links 26, 27 from their spread position (Fig. 12) into their folded position (Fig. 11).

In this form of construction not only the box bar 12 has a rack 18 in which a spur wheel rotatable from the cockpit meshes, as in the construction shown in Figs. 2 to 6 (see particularly Fig. 6), but also the T-bar 13 has a toothed portion 18′ (see also diagram of Fig. 10 in which for the sake of clearness the two bars are shown one below the other in the same plane). With this toothed portion 18′ meshes a small spur wheel 20 connected to the spur wheel 20 by intermediate wheels (only one of which is shown in the diagram), so that, when both the spur wheels 20, 20′ engage in their corresponding racks 18, 18′ and the spur wheel 20 is rotated, the box bar 12 moves more rapidly than the T-bar 12. Furthermore, the two racks 18, 18′ (Fig. 8) are of different lengths and their mutual arrangement is such that when the aileron and flap being in inoperative position (Fig. 7) only the rack 18 and the spur wheel 20 but not the rack 18′ and the spur wheel 20′ are in engagement (Fig. 10) and the engagement between the two elements 18′ and 20′ only takes place when the T-bar 13 has been shifted to the rear a predetermined distance. On the other hand the rack 18 extends farther forward than the rack 18′ with the result that the box bar 12 can continue to move after the movement of the T-bar 13 has terminated.

The aileron II carries the pivot axle 28 of a bell crank lever 29, 30 (see also Figs. 11, 12) having a long arm 29 with a longitudinal slot 31 and a short arm 30 which, by a link 32, is connected with the pivot axle 25 of the above mentioned lever 26, 27. The slot 31 in the arm 29 is open at the extremity of this arm so that the arm 29 can cooperate in the following manner with a pin 33 fixed on one of the U-bars.

When the aileron II is in its inoperative position the lever arm 29 and pin 33 are in the position shown in Fig. 11, in which the pin 33 is standing just at the open end of the slot 31. If the aileron II is then moved rearwards, the bell crank lever 29, 30 is actuated by the pin 33, which moves first inwards and then outwards in the slot 31, in such a manner that this lever 29, 30 is turned about its axle 28 out of the position shown in Fig. 11 into that shown in Fig. 12. In this position the pin 33 is once again at the open end of the slot 32 so that if the aileron II is moved farther in rearward direction the bell crank lever 29, 30 is not prevented from participating in this movement and from moving away from the pin 33 (Fig. 12 towards the ring). During the return movement of the aileron II, however, the arm 29, provided the bell crank lever 29, 30 has not changed its angular adjustment in the meantime, again cooperates with the pin 33, which then acts in the opposite sense to that in which it acted during the rearward movement of the aileron II, returns the bell crank lever 29, 30 into its initial position (Fig. 11). The above mentioned movement of the bell crank lever 29, 30 out of the position shown in Fig. 11 into that shown in Fig. 12 also results in the levers 26, 27 being shifted into the spread position shown in Fig. 12.

If the spur wheel **20** is rotated when the parts are in the inoperative position shown in Fig. 7, first only the box bar **12** will be shifted but, owing to the spring, (not shown) inserted between the box bar **12** and the T-bar **13**, the T-bar **13** will be shifted in the same direction. Therefore, the box bar **12** and the T-bar **13** move rearwardly together, the aileron II and the flap III participating in this movement. During this displacement of the bars **12**, **13** and of the aileron II and flap III the bell crank lever **29**, **30** is swung out of the position shown in Fig. 11, in the manner described, into that shown in Fig. 12. During this movement the link **32** presses the levers **26**, **27** gradually into the spread position Fig. 12, so that the flap III is swung downwards about the trailing edge of the aileron and positively set relative to the rear end thereof. The aileron and the flap are then in the position indicated in dot-dash lines in Fig. 8. In this position the engagement between the spur wheel **20'** (Fig. 10) and the rack **10'** on the T-bar **13** commences so that, from this moment onwards, this bar will also be rearwardly shifted but more slowly than the box bar **12**. The pivot axle **16** of the nose of the aileron II therefore approaches the upper point of articulation of the link **17** connecting the aileron to the T-bar **13**, so that the aileron II commences to swing downwards and passes into the position shown in solid lines in Fig. 8. This position is reached when the two bars have moved back so far that the front end of the rack **13'** stands opposite the spur wheel **20'**. At this moment the sliding movement of the T-bar **13** which is possible is ended by an abutment (not shown) in the path of the T-bar **13** or of the guide rollers **15** (Figs. 5, 6) of the same, so that further rotation of the spur wheel **20** merely leads to additional rearward displacement of the box bar **12**, which results in a further turning of the aileron II in the positive sense into the position shown in Fig. 9.

During the whole of the displacement of the aileron from the position shown in Fig. 8 into that shown in Fig. 9 the flap III remains in the positively adjusted position relatively to the trailing edge of the aileron. The bell crank lever **29**, **30** cannot turn automatically about its axle **28** because, on the one hand, the arm **30** of this bell crank lever **29**, **30** is below the dead centre position of this lever arm determined by the position of the link **32** and, on the other hand, the above mentioned, now tensioned spring (not shown) which is introduced between the jib **24** of the aileron II and the flap III, and also the air pressure acting on the flap III in the same direction as this spring, tend to move the arm **30** of the bell crank lever **29**, **30** still further away from its dead centre position, instead of closer thereto. Consequently, the above mentioned condition is estabilshed namely that during the return movement of the aileron II into its initial position the bell crank lever **29**, **30** is swung back about the pin **32** out of the position shown in Fig. 12 into that shown in Fig. 11.

Figs. 13 and 14 show two modifications of a form of construction similar to that illustrated in Fig. 1. In one instance (Fig. 13) the aileron bears without gap against the wing, and in the other instance there is always a nozzle-like gap between the wing I and the aileron II when the aileron II is in its inoperative, swung down position.

The aileron II is oscillatable about a transverse axle **34** mounted on wing I. As in the construction illustrated in Fig. 1, the flap III is arranged within the profile of the aileron in a recess in the upper side thereof. The flap III is also in this instance supported by two links **4**, **5** which are pivotally mounted in a plate **6** on the under side of the aileron II.

A control lever **37** connected to the aileron II by a link **36** and a sprocket wheel **38** or a rope pulley are keyed on a common axle **35** in the wing I. A lever **40** connected with the nose of flap III by a connecting rod **39** and a sprocket wheel **41** (or rope pulley) connected with the opposite larger sprocket wheel **38** (or rope pulley) by a crossed chain gear **42** (or rope gear) sit loosely on the pivot axle **34** of the aileron II but are coupled the one with the other. If the control lever **37** is swung in clockwise or anti-clockwise direction the aileron II is swung downwards or upwards and at the same time the flap III is adjusted relatively to the aileron II through the intermediary of the lever system **39**, **40** in such a manner that a nozzle-like gap is formed between the aileron and flap.

JOSEPH KSOLL.

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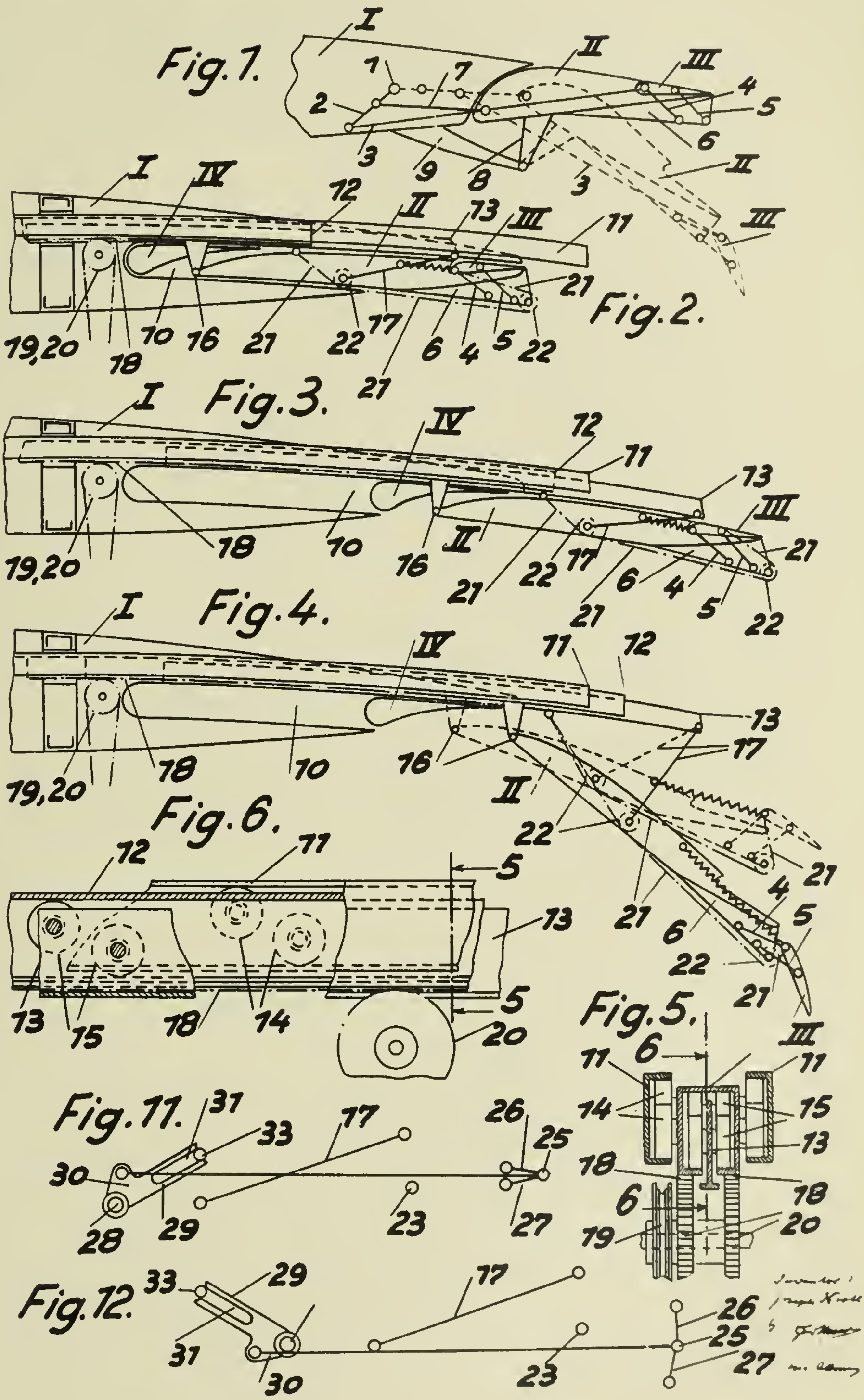

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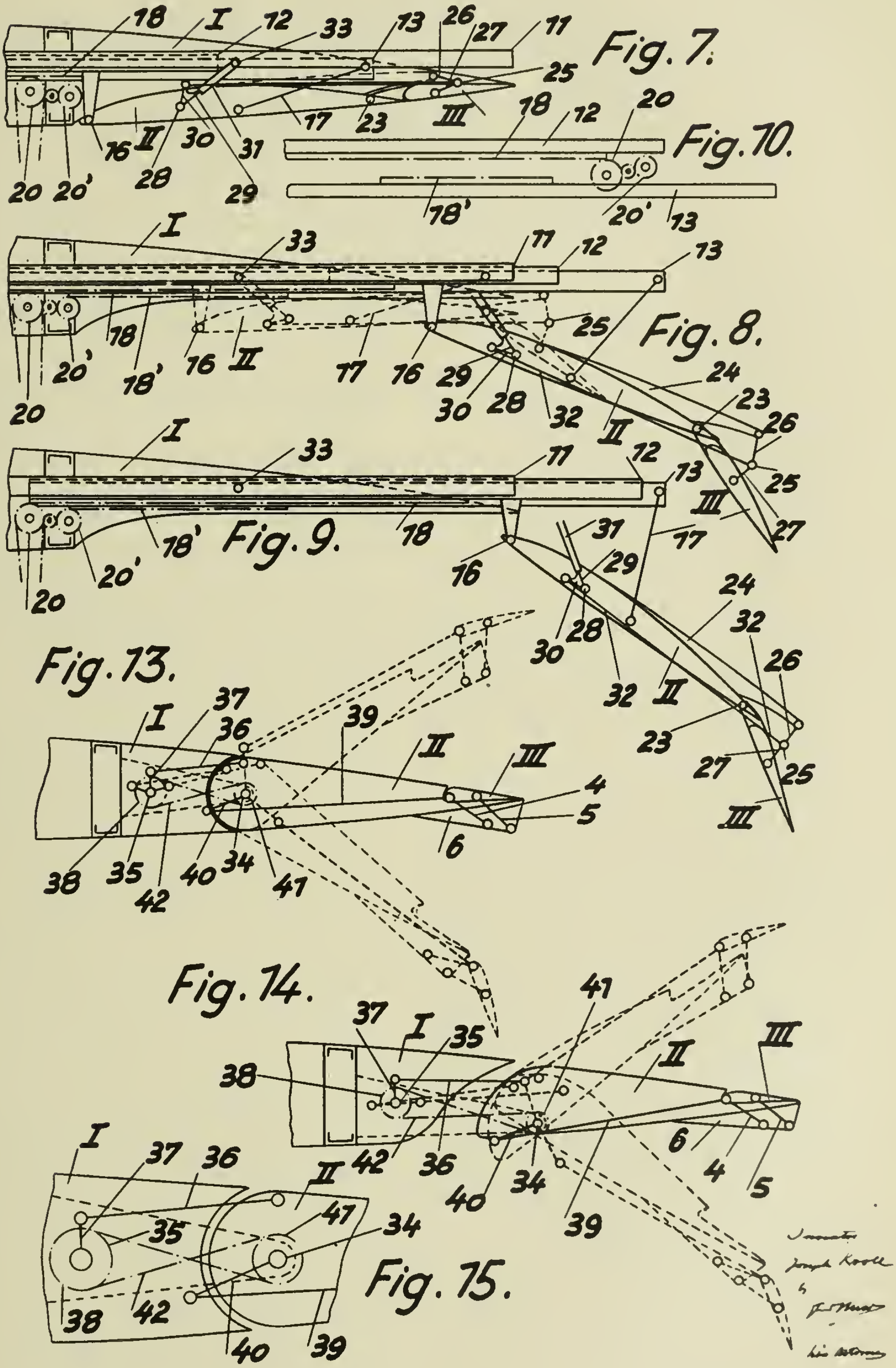

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ALIEN PROPERTY CUSTODIAN

TYPEWRITING-CALCULATING MACHINES WITH TOTAL TAKING MECHANISM, AND TO SIMILAR MACHINES

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Application filed January 18, 1939

This invention relates to typewriting-calculating machines with total taking mechanism, and to similar machines.

According to the invention, any or all of the totalizers in a machine of the class specified are combined with accumulators or summing-up devices, and each accumulator is arranged to be selectively coupled with the corresponding totalizer. The units comprising a totalizer and its accumulator, will be referred to as "double totalizers."

By these means, values which have been introduced into the totalizers, are accumulated for later use, so that calculations involving accumulation of values, are easy and simple.

In the accompanying drawings, an accounting machine to which the invention has been adapted, is illustrated partly by way of example.

In the drawings

Fig. 1 is a perspective illustration, viewed from the front and the left, of a double totalizer comprising a column totalizer mounted on the totalizer suspension rail of the paper carriage, and the accumulator allotted to the column totalizer.

Figs. 2, 3 and 4 are sectional elevations taken on the line 2—2 in Fig. 1 and drawn to a larger scale.

Fig. 2 shows the accumulator uncoupled from the totalizer.

Fig. 3 shows the two parts coupled in such manner that the accumulator is operated subtractively upon additive operation of the totalizer.

Fig. 4 shows the parts coupled in such manner that the accumulator is operated additively upon additive operation of the totalizer.

Fig. 5 is a perspective illustration of the mechanisms at the three lowermost places, including the comma place, viewed from the front and the left, parts being shown at a distance from each other for the sake of clearness.

Fig. 6 shows part of a train of gears in the hundredths place connecting the totalizer and the accumulator.

Fig. 7 is a section through all calculating places of the double totalizer on the line 7—7 in Fig. 6, viewed in the direction of the arrows, the axes of all gears being shown in a vertical plane.

Figs. 8 and 9 are perspective details relating to Fig. 7.

Figs. 10 and 12 show details of the train of gears illustrated in Fig. 7.

Figs. 11 and 13 are, respectively, sections through the axes to the gears in Figs. 10 and 12, the axes being again shown in a vertical plane.

Figs. 14, 15 and 16 are elevations of the double totalizer, viewed from the left in Fig. 1 and showing its manipulating handle in three distinct positions.

Fig. 17 is a perspective illustration of the accumulator, with its casing partly broken open.

Fig. 18 is a detail relating to Fig. 17, shown in perspective and drawn to a larger scale.

Fig. 19 is a perspective illustration showing the side walls of the double totalizer, and part of its mechanism viewed from the left and the rear.

Figs. 20 and 21 are elevations of the double totalizer, viewed from the right in Fig. 1 and showing two distinct positions of the means for securing the double totalizer to the totalizer suspension rail of the paper carriage.

Fig. 22 is a diagram of a modified arrangement.

(1) *General description*

The column totalizer **1** and the accumulator **2** make up together a double totalizer.

In the example illustrated, the accumulator **2** is mounted to swing at the top of the column totalizer **1**, and can be selectively coupled with the column totalizer **1**. By a U-shaped manipulating lever **3** the accumulator **2** can be coupled with the column totalizer **1**, and the species of the accumulator **2** can be set preliminarily.

The cover **4** of the accumulator **2** is slotted at **5** to display number rollers **6** forming part of the accumulator **2**. The numbers "0" to "9" are placed on the rollers in anti-clockwise sequence. The cover **7** and a controlling plate **8** of the column totalizer **1** define a slot **9** displaying number rollers **10** forming part of the column totalizer **1** on which are also placed the numbers "0" to "9" in anti-clockwise sequence.

The means for securing the column totalizer **1** to the totalizer suspension rail **11** of the paper carriage, not shown, of the accounting machine on which it is suspended will be fully described in section **15** "The suspension and securing means for the column totalizer and the accumulator" with reference to Figs. 19, 20 and 21.

(2) *The arrangement of the mechanism in the column totalizer*

Referring now to Figs. 1 and 2, a bar 15 extends through the frame of the column totalizer **1** and is held against its side plates **13** and **14** by screws **16**. A locking lever **17** (Fig. 5) is mounted to

swing on the bar 15 for the hundredths place of the column totalizer 1.

At its rear end, this locking lever 17 has a fork 18 and when the locking lever of the hundredths place of the column totalizer 1 moves into active position, a releasing finger 19 whose upper end is shown in Fig. 2, engages in the fork for preparing the corresponding place for a calculating operation. A spring 21 whose upper end is attached to the locking lever 17 and whose lower end is anchored to a rod 20 secured in the side plates 13 and 14 of the column totalizer 1, tends to turn the locking lever 17 clockwise about the bar 15. The normal position of the locking lever 17 is defined by an abutment 22 on the locking lever 17 bearing against an adjustable screw 23 in a transverse bar 24 which is secured between the two side plates 13 and 14 of the vertical totalizer 1.

In this normal position, a tooth 25 on the locking lever 17 engages in a gap between the teeth of a spur gear 26. The spur gear 26 is mounted to rotate on a shaft 32 which is secured to the side plates 13 and 14 by screws 31. It is equipped with three tens-transfer teeth 27 and a flange 30 which has a semi-cylindrical recess 29 opposite each tens transfer tooth 27. The arrangement of the spur gear on the shaft 32 is best seen in Fig. 7. The spur gear will be referred to as the "main driving wheels 33."

The locking lever 17 is equipped with a tooth 34 positioned between the bar 15 and the abutment 22 for cooperation with a locking lever in the accumulator 2, as will be described in section 6, "The arrangement of the mechanism in the totalizer." In the present instance, this is the locking lever of the hundredths place in the accumulator 2.

An extension 35 of the locking lever 17 beyond the abutment 22 is forked at 36 and has prongs 37 and 39 cooperating, respectively, with inclines 38 and 40, Fig. 8.

Mounted to rotate on a rivet 42 in the free end of the coupling arm 41 is a coupling spur gear 43. A shaft 61 is secured in the end plates 13 and 14 of the column totalizer 1, and on it pairs of transmission spur gears 44, 45, (Fig. 7), are mounted for free rotation. The width of each coupling gear 43 is equal to the overall width of a pair of gears 44 and 45, so that the coupling gear engages at the same the two otherwise freely rotatable transmission gears 44, 45.

The left-hand side of the coupling arm 41 is recessed at 46 for the reception of another coupling gear which is similar to the gear 43, but is allotted to the next higher place of the column totalizer 1. In the normal position of the coupling arm 41, the coupling gear 43 rests on a locking bar 48, Fig. 2 which is secured in the side plates 13 and 14 of the column totalizer 1 and, by engaging in a gap of the gear 43, holds the coupling arm 41 against swinging anti-clockwise about the shaft 51, preventing unintentional rotation of the coupling gear 43 in its inactive position.

The coupling arm 41 is not mounted directly on the shaft 51 but is seated on the boss 49 of a spur gear 50, Fig. 8, which in turn is mounted to rotate on the shaft 51. The boss or distance sleeve 49 bridges the distance to the next higher place, as shown in Fig. 7. It will be understood that in this manner the coupling arm 41 and the sleeve 49 can turn independently of each other.

The spur gear 50 meshes with a spur gear 52 which is mounted for free rotation on a shaft 54, secured to the side plates 13 and 14 by screws 53. The spur gear 52 is made integral with zero setting disc 55 which has two zero setting teeth 56, for cooperation with the usual zero stop 57 in Fig. 5. The spur gear 52 also meshes with the teeth 26 of the main driving wheel 33.

The number roller 10 of the hundredths place is provided with a spur gear 58, Fig. 5, meshing with the spur gear 52. The number roller 10, with its spur gear 58, is mounted to rotate freely on a shaft 60 which is secured in the side plates 13 and 14 of the column totalizer 1 by screws 59.

The spur gear 50, meshes with the transmission gear 44 on the shaft 61. The corresponding transmission gear 45 is mounted at the right of the gear 44. If the gears 44 and 45 are not in active position, the same are free to rotate quite independently of each other, so that any tens transfer in the column totalizer 1 is performed independently of the accumulator 2, and vice versa. Transfer of value is only possible from the column totalizer 1 to the accumulator 2 in active position, in which the transmission gears 44, 45 are connected by the wide coupling spur gear 43 on the arm 41 and now rotate as a unit.

The transmission gears 44 and 45 are spaced apart by their bosses 62 extending beyond the body of the gear, as shown for a gear 44 in Fig. 9, and their teeth are so short that a free space 63 is formed at one side. The clearance made up by the bosses 62 and the set-back of the teeth at 63 is indicated by 64 in Fig. 7 and can be entered by tens transfer cams 65, Fig. 5, on driving wheels 66 in the accumulator 2 on a shaft as will be fully described in section (6).

A flap 67 extends all over the ten calculating places in the column totalizers 1 and is mounted in the side plates 13 and 14 by trunnions 68 for cooperation with the back of the abutment 22.

A shaft 70 is secured in the side plates 13 and 14 of the column totalizer 1 by screws 69. On this shaft 70, a locking-wheel lever 71, Fig. 5, is arranged at that decimal place of the column totalizer 1 which is the next higher from the hundredths place, to swing about the shaft. A spring 72 which is attached to the locking-wheel lever 71 at one end, and anchored to the rod 20 at the other, tends to turn the lever 71 clockwise about the shaft 70, and its normal position is defined by an abutment 73 on the lever engaging an adjustable screw 74 in the transverse bar 24. The back of the abutment cooperates with the flap 67.

A fork 75 at the rear end of the locking-wheel lever 71 is arranged to cooperate with the releasing finger 19, Fig. 2, when the decimal place of the column totalizer 1 moves into active position. The finger 19 prepares the corresponding calculating place for a calculating operation.

A tooth 76 on the locking-wheel lever 71 which corresponds to the tooth 34 of the locking lever 17 at the hundredths place, is bent to the right for one calculating place for cooperation with a locking lever 77 in the accumulator 2, as will be described in section (6).

Arranged on the locking-wheel lever 71 are mounted to turn about a rivet 78, a spur gear 79, Figs. 2 and 13, a Malthese gear 80 and a spur gear 81. The parts 79, 80 and 81 make up together the usual locking and tens transfer wheel and the individual wheels will be referred to as the locking wheel 82. The spur gear portion 79 of the locking wheel 82 of the tenths decimal calculating place meshes with the teeth 83 of the driving wheel 84 which is allotted to the tenths decimal place of the column totalizer 1 and cor-

responds to the main driving wheel 33 of the hundredths calculating place.

The Malthese wheel portion 80 of this locking wheel 82 bears on the flange 30 of the main driving wheel 33 of the hundredths calculating place, and the spur gear portion 81 of the locking wheel 82 can cooperate with the tens-transfer teeth 27 of the main driving wheel 33.

A locking bar 35 extends through a slot 86 in the locking-wheel lever 71 and is secured in the side walls 13 and 14. In the inactive position, a gap between the teeth of the Malthese portion 85 of the locking wheel 82 of the tenths decimal places engages over the locking bar 85, as shown in Fig. 2.

A forked member 87 of the locking-wheel lever 71 engages the free end 88 of a coupling lever 89, as best seen in Fig. 5. The coupling lever 89 and the coupling wheel 47 which is mounted to turn on it, correspond as to their arrangement to the coupling arm 41 and its coupling gear 43 for the hundredths calculating place. As plainly shown in Fig. 5, the train of gear allotted to the hundredths place and comprising the gear wheels 33, 53, 55, 56, 58, 10, 44 and 45 is also allotted to the tenths decimal calculating place and these parts of the tenths decimal place will not be detailed.

In the next higher, or comma, place of the column totalizer 1, a calculating operation must not occur. To prevent a calculating operation, a comma locking member 90, Figs. 2, and 5, is provided on the shaft 15 of the column totalizer 1 which abuts against the rod 20 with a tooth 91. The member 90 is forked at its lower end 92, Fig. 5, and when the parts move into active position, the finger 19 engages in this fork 92 and cannot perform its movement in the direction of the arrow 93 in Fig. 2, since the tooth 91 bears against the rod 20 and arrests the comma locking member, so that no calculating operation can be started in the column totalizer.

It may be necessary to effect a tens transfer from the tenths decimal place of the column totalizer 1 to the units calculating place in the same column totalizer. For this purpose, the main driving wheel 94, as shown in Fig. 7, which is allotted to the comma place, is connected to the main driving wheel 84 of the tenths decimal calculating place by rivets 95 so that the main driving wheels 94 and 84 act as a unit.

In the comma place, instead of the trains of gears allotted to all other calculating places of the column totalizer 1, a spacer 96, Fig. 7, is inserted on the corresponding shafts 54 of the totalizer, and a blank roller 97 is arranged on the shaft 60, Fig. 1, instead of a number roller 10.

The mechanisms described for the hundredths and tenths decimal places of the column totalizer 1, as shown in Fig. 5, are also allotted alternately to the next higher calculating places that is, the units, tens, hundreds, etc., places. The arrangement of these parts will therefore not be detailed. It should be noted, however, that the locking levers of the units calculating places etc., are equipped with a unit locking wheel as wheel "82" in the tenths decimal place (Fig. 5).

At the left of the units calculating place, a lever 98, as best seen in Fig. 5, is mounted to swing on the shaft 15. Its upper end 99 extends forwardly and into a notch in the flap 67 at 100. A holding member 101 is attached to the flap 67, and its rear arm 102 is positioned below the end 99 of the lever 98. A spring 103 which is attached to the lever 98 at one end, and anchored on the rod 20 at the other, tends to turn the lever 98 clockwise about the shaft 15 and the end 99 of the lever 98 exerts pressure on the arm 102 at the rear end of the holding member 101 of the flap 67, the holding member 101 turning the flap 67 anti-clockwise about its trunnions 68. In consequence, the flap 67 bears on the backs of the abutments 22 and 73 of the respective locking and locking-wheel levers 17 and 71 alloted to the calculating places of the column totalizer. This is the normal position of the flap 67 and to it corresponds the normal position of the lever 98 in which a locking tooth 104 on the lever 98 engages in that gap between the teeth 105 of the main driving wheel 106 of the tens place which is presented to the tooth at the time. By these means, the slack of the main driving wheels 33, 84 etc. produced by their cooperation with the locking wheels 82, 107 and so on, and in the connected trains of gears at the individual places of the column totalizer 1, is made up for.

The arrangement of such a lever 98 and the parts cooperating therewith has also been selected at the left of the eighth calculating place or ten thousandths place.

(3) *The operation of the column totalizer when a value is introduced*

The operations which are performed when a value is introduced into the column totalizer 1, are substantially similar in the individual calculating places, and therefore only the introduction of a value into the units calculating place of the column totalizer 1 will be described by way of example.

When the locking wheels 82, 107 etc., of the individual calculating places engage in the teeth of the main calculating wheels 84, 111 etc., with their spur gears 79, 108 (Fig. 2), the main driving wheels 84, 111 cannot be rotated. Unintentional rotation of each individual main driving wheel 33, 84, 111 etc., is prevented by the teeth of the Malthese wheel 80, 112 of the locking wheels 82, 107 etc., which bear on the flange 30, 119 of the main driving wheel 33, 84, 111 etc. allotted to the next lower calculating place.

After the units place of the column totalizer 1 has moved into active position, and the well known calculating key—not shown—for the value to be introduced has been depressed the releasing finger 19 is turned in the direction of the arrow 93, and, since it projects into the fork 113 of the locking lever 114 allotted to the units place, it swings the locking lever anti-clockwise about the bar 15, Fig. 3, against its spring 115. At the same time, the abutment 116 of the locking lever 114 is lifted clear of the screw 117 in the bar 24 and the flap 67 is swung clockwise about its trunnions 68. The arms 102 of the holding members 101 secured in the flap 67 act on the arms 99 of the two levers 98 in Fig. 3, only one lever 98 is illustrated and swing the levers 98 anti-clockwise about the bar 15 against their springs 103. The locking teeth 104 of the levers 98 clear the teeth 105 of the main driving wheels 106 and 118 so that these are free to turn. The locking wheel 107, Fig. 13. of the locking lever 114 at the units place partakes in its anti-clockwise movement, and the spur gear 108 of this locking wheel 107 clears the teeth 110 of the units main driving wheel 111. At the same time, the Malthese wheel 112 is moved off the flange 119 of the main driving wheel 94 of the comma place, and since the flange 121 (Fig. 7) of the main driving wheel 111 of the units place can

rotate freely past the teeth of the Malthese wheel **122** of the locking wheel **123** at the next higher place, that is, the tens place, the main driving wheel **111** of the units place can be turned by driving wheel **12**.

When the locking lever **114** of the units place has been swung anti-clockwise by the finger **19**, one of the gaps of the Malthese wheel **112** at the locking wheel **107** engages about the bar **124** and thus prevents rotation of the locking wheel **107** on the said locking lever **114**.

When the locking lever **114** of the units place is swung anti-clockwise, the prong **125** of the fork **126** at the end of the arm **127** of the locking lever **114** engages the edge **128** of the coupling arm **129** at the units place a short time after the locking lever has started and swings the coupling arm **129** clockwise about the boss **138** of the corresponding spur gear **130** and the coupling gear **131** on the arm **129** partakes in this movement and clears the locking bar **48**. When the coupling arm **129** has completed its movement the coupling gear **137**, as shown in Fig. 11 meshes with the pair of transmission wheels **132**, **133** at the units place.

The value is now introduced into the column totalizer **1**, and the driving wheel **12** is rotated in the direction of the arrow **134** through an angle corresponding to the value introduced. Since the wheel **12** meshes with the teeth **110** of the main driving wheel **111** of the units place, this wheel is rotated in the direction of the arrow **135** in Fig. 3, and transfers the value to the wheels **136**, **130** and **137** which rotate in the directions of the arrows **135** in Fig. 3. The number roller **10** of the units place partakes in the rotation of its spur gear **137** in the direction of the arrow **135** and displays the value in the inspection opening **9** in the cover plate **4** of the column totalizer **1**. The transmission of the rotation of the spur gear **130** to the corresponding transmission gear **132** and to the accumulator **2** through gears **131** and **133** will be described in section (6).

When the value has been introduced, the releasing finger **19**, returns into its initial position, as shown in Fig. 2, and releases the locking lever **114** whose abutment **116** now is returned against the screw **117** in the bar **24** by its spring **115**. At the same time, the back of the abutment **116** releases the flap **67** and, through parts **99**, **101** and **102**, the levers **98** return into their initial positions, Fig. 2, under the pull of their springs **103**. Their teeth **104** now re-engage the gaps between the teeth **105** of the allotted main driving wheels **106** and **118**.

The locking wheel **107** of the locking lever **114** at the units place partakes in the return of this lever into its normal position and the spur gear portion **108** engages in the teeth **110** of the main driving wheel **111** of the units place. The Malthese portion **112** of this locking wheel **107** re-engages the flange **119** of the main driving wheel **94** at the comma place, and locks the main driving wheel **111** against rotation.

When the locking lever **114** returns, the prong **125** of its fork **126** release the edge **128** of the coupling arm **129** at the units place which now swings about the boss **138** of the spur gear **130** by gravity. When the locking lever **114** has about completed its return, the prong **139** of the fork **126** re-engages the edge **140** of the coupling arm **129**, causing a gap in the coupling gear **131** to engage about the locking bar **48**.

The operations performed in the units place are now completed, the value is typed on the paper supported by the paper carriage, and the carriage is fed for the next steip.

(4). *The tens transfer in the column totalizer*

If, owing to the preceding introduction of a value, such value is already present in the units place of the column totalizer **1**, and a tens transfer to the tens place becomes necessary by the introduction of the subsequent value, this is performed as follows while the value is being introduced:

It is known that the number rollers **10** rotate clockwise. When the number roller **10** of the units place turns from "9" to "10", one of the tens transfer cams **140** of the main driving wheel **111** of the units place, which rotates anti-clockwise strikes a tooth **142** of the locking wheel **123**, Fig. 13, on the locking wheel lever of the tens place, and the locking wheel **123** is turned clockwise through one pitch. This turning is not interfered with by the Maltese wheel **122** since when the locking wheel **123** is turned, one of the recesses **143** in the flange **121** of the main driving wheel **111** of the units place is presented to the corresponding tooth of the Maltese wheel.

When the locking wheel **123** at the tens place is turned through one pitch, the main driving wheel **106** of the tens place is rotated anti-clockwise about the bar **32** since the spur gear portion of the locking wheel **123** meshes with the teeth **105** of the main driving wheel. Through the train of gears **145**, **146** Fig. 7 which corresponds the gears **136**, **130** a unit is transferred to the number roller **10** of the tens place in additive direction. The transmission gear **147** Fig. 11 of the tends place is also turned for one unit but does not exert any action. To prevent rotation of the gear **148** during this idle movement of **147**, means such as a blade spring **149** Fig. 2 in the shape of a comb may be provided, with tongues **150** projecting into a gap in each of the gears **148**, **133** etc. at the individual places. After the locking wheel **123** of the tens place has been moved through one unit, the main driving wheel **111** of the units place has turned so far that the solid portion of the flange **121** on the main driving wheel **111** is again presented to the Maltese wheel **122** of the locking wheel **123** and this is locked.

(5) *The operation of the column totalizer when total taking*

When it is desired to eliminate the value which has been introduced, by total taking, the following operations occur in the individual places of the column totalizer, as will now be described for the units place.

When the units place of the column totalizer has moved into calculating position, the well known total taking key, not shown, is depressed and the releasing finger **19** is turned in the direction of the arrow **93**, turning the locking lever **114** anti-clockwise about the bar **15**. This swinging movement of the lever **114** causes the unlocking of the train of gears **111**, **136**, **151**, **130**, **137** as described in section (3).

Furthermore the zero stop **57** is shifted in the direction of the arrow **153** in Fig. 5, and moved into the path of the two zero setting teeth **154** on the disk **151** of the spur gear **136**, Fig. 5.

Now, the main driving wheel **12** is rotated against the arrow **134** in Fig. 5, and the main driving wheel **111** of the units place and the train of gears **136**, **151**, **130** and **137** allotted to the

units place are driven in the direction of the arrows 155 in Fig. 3. At the movement the number roller 10 of the units place is turned from "1" to "0", one of the zero setting teeth 154 on the disk 151 of spur gear 136 engages the zero setting stop 57, Fig. 5, and limits the rotation of the said train which occupies its zero position, as shown in Fig. 2. At this moment, the releasing finger 19 releases the locking lever 114 of the units place whereupon this, and the parts connected to it, return into their initial positions, as also described in section (3), and shown in Fig. 2. The zero setting stop 57 is returned into its normal position against the arrow 153 in Fig. 5.

The Accumulator

(6) The arrangement of the mechanism in the accumulator

The accumulator 2 is pivoted on the shaft 158 which is secured in an eye 156 of the right-hand side plate 13 and in an eye 157 of the left hand side plate 14, of the column totalizer 1, as best seen in Fig. 19. Inwardly crooked bearings 159*a* and 160*a* respectively, on the right- and left-hand side plates 159 and 160 of the accumulator 2 are placed on the shaft 79 between the eyes 156 and 157.

The side walls 159 and 160 of the accumulator 2 are connected by transverse bracing members 161, 162 and 163, Figs. 2, 3 and 4, to which the cover plate 4 is secured by screws 164 Fig. 1.

At the front side of the double totalizer, lugs 167 and 165 on the side plates 159 and 160, respectively, of the accumulator, are arranged for cooperation with abutments 168 and 166 on the respective side plates 13 and 14 of the column totalizer 1, as best seen in Fig. 19. A crooked guiding strip 170 projects upwardly from the side plate 13 of the column totalizer 1, and a similar strip 169 is provided on the other side plate 14 as best shown in Figs. 14 to 17.

In the lowest calculating place, that is, in the hundredths place of the accumulator 2, the following parts are arranged.

The transmission spur gear 45 of the said place is arranged for cooperation with the teeth 141 of a driving wheel 66 on the shaft 175. The driving wheel 66 as shown in Figs. 5, is similar to the driving wheels 33 in the column totalizer 1, having three tens transfer teeth 65 and a flange 174 with depressions 173. A pinion 176 on a shaft 177 meshes with the teeth 171 of the driving wheel 66. The ends 178 and 179 of the shaft 177 are guided in slots 180 and 181 in the side plates 159 and 160, respectively.

Arranged above the shaft 177 is another shaft 183 which is secured in the side plates 159, 160 of the accumulator 2 by screws 182, Fig. 1, and support a wheel 184 meshing with the teeth 171 of the driving wheel 66. This pinion, through a spur gear 185, operates the number roller 6 of the hundredths place of the accumulator 2 shown in Fig. 1. All the number rollers 6 of the accumulator are mounted to rotate about a shaft 187 which is held by screws 186. The arrangement of the numbers on the roller 6 is shown in Fig. 3, and is similar to that of the numbers on the rollers 10.

In the initial position of the hundredths place of the accumulator 2, a locking tooth 188, Fig. 5, on a locking lever 189 engages in one of the gaps between the teeth 171 of the driving wheel 66, holding the wheel 66 against rotation. The locking lever 189 is mounted to swing about a shaft 191 which is secured by screws 190, Fig. 1. A spring 192 which is attached to the upper end of the lever 189 and anchored on a rod 194, pulls the lever against a screw 197 which is adjustable in a bar 196, this being the normal position of the lever 189. The ends 198 of the bar 196 are inserted in holes 199 of the side plates 159 and 160, and held against turning. Only the hole 199 in the side plate 159 is shown in Fig. 5.

The tooth 200, with its curved front edge 201 at the lower end of the locking lever 189 which is engaged by the tooth 34 of the locking lever 17 is already described in Section 2.

An incline 202 is provided on the back of the locking lever 189 for cooperation with a locking flap 203. The flap 203 has a pair of headed trunnions 204, one of which is shown at the right in Fig. 19, mounted to rotate in the side plates 159 and 160, and extends over all the ten calculating places of the accumulator 2. A curved face 205 at the front side of a hook 206 on the flap 203 can cooperate with the rear edge 207 of a lug 208 on the locking lever 189, and can also project into a recess 209, in the rear edge of the locking lever 189.

A locking bar 211 secured in the side plates 159 and 160 extends, with a clearance, through a slot 210 in the locking lever 189.

A shaft 212 is secured at the rear of the shaft 191 in the side walls 159, 160 by screws 213, Fig. 1. A locking wheel lever 77, Fig. 5, is mounted to swing about this shaft in the tenths place of the accumulator. A spring 215 anchored on a rod 214 holds an abutment 216 of the lever 77 against a screw 217 in the bar 196. A tooth 218 at the lower end of the locking wheel lever 77 has a curved front edge 219 for cooperation with a crooked lug 76 on the locking wheel lever 71 at the tenths calculating place of the column totalizer, as shown in Fig. 5.

An incline 220 on the back of the locking wheel lever is arranged for cooperation with the locking flap 203, whose curved front edge 205 can cooperate with the edge 221 of a lug 222 on the locking wheel lever 77, or project into a recess 223 in the lever 77.

A locking bar 225, Fig. 2, secured in the side plates 159 and 160 extends, with a clearance, through a slot 224 in the lever 77.

A headed rivet 226 is inserted in the lever 77 and supports a tens transfer and locking wheel 227 which will be briefly referred to as the locking wheel and is similar to the locking wheel 82 at the tenths place in the column totalizer 1. The locking wheel 227 comprising a spur gear 228, a Maltese wheel 229, and a spur gear 230, Fig. 11. The teeth 228 of the locking wheel 227 mesh, in the initial position of the lever 77, as shown in Fig. 2, with the teeth 231 of the driving wheel 232 which is allotted to the tenths place and corresponds to the driving wheel 66 of the hundredths place. The Maltese teeth 229 of the wheel 227 rest on the flange 174, Fig. 11, of the driving wheel 66 in the hundredths place, and the other set of teeth 230 can cooperate with the tens transfer teeth 65 of the flange 172 of the wheel 66.

As appears from Fig. 5, a train of gears 233, 234, 235 and 6 is allotted to the tenths calculating place which corresponds to the train of gears of the hundredths calculating place, and so these parts of the tenths calculating place will not be described.

The next higher place is the comma place where no values must be transferred to or from the column totalizer 1. This place is consequently

without the train of gears and locking levers of the other places. The driving wheel **232** of the tenths calculating place, Fig. 11, is connected to the driving wheel **236** at the comma place by rivets **237** for the purpose of any tens transfer which may be required from the tenths place to the units place. Instead of a number rollers **6**, a blank roller **238**, Fig. 7, is allotted to the comma place, while a spacer **239**, Fig. 5, is arranged on the shafts **183** and **191**.

The parts allotted to the next higher, that is, the units place, in the accumulator, correspond substantially to those of the hundredths place, but the locking lever **240** of the units place is equipped with a locking wheel **241**, as allotted to the tenths place. The teeth **242** (Fig. 2) of this locking wheel **241** mesh with the teeth **243** of the driving wheel **244** of the same place, its Maltese wheel **245** is arranged to cooperate with the flange **246** of the driving wheel **236** of the comma place, and its teeth **247** to cooperate with the tens-transfer teeth **248** of the flange **249** on the wheel **236**.

The parts which have been described with reference to the hundredths and tenths calculating places of the accumulator **2**, are also allotted, alternately units to the tens, hundreds, etc. calculating places in the accumulator, and will not be detailed.

Mounted to swing on the shaft **191** at the left-hand side of the locking wheel lever **240** at the units place of the accumulator **2** is a three-armed lever **250**. A tooth **251** at the end of the arm **252** of this lever engages in a notch **253** in the flap **203** and is arranged to cooperate with an arm **254** of a member **255** which is fixed in the flap **203** behind the notch **253**. A spring **257** connected to another arm **256** of the lever **250** and anchored on the rod **194** turns the lever anti-clockwise and causes its tooth **251** to swing the flap **203** clockwise through the arm **254** of the member **255** until the flap bears on the inclines **258** or **220** of the respective locking and locking wheel levers **189** and **77**, and this defines the normal positions of the flap **203** and of the three-armed lever **250**. In this normal position, a tooth **260** at the free end of the third arm **259** of the lever engages between the teeth **261** of the driving wheel **262** at the tens place, and this makes up for the slack resulting from the cooperation of the driving wheels **66**, **232** etc., and the locking and tens transfer wheels **227**, **241** etc. which increases from place to place.

A tooth **263** projects from the rear edge of the three-armed lever **250** for cooperation with a stay **264** in a locking frame **265**. This frame, as best seen in Fig. 17, comprises a pair of arms **266** and **267** which are mounted to swing about a shaft **270** secured to the side plates **159** and **160** of the accumulator **2** with their rear ends, and with their front ends support a rod **269** which has the profile of a tooth and extends over all the driving wheels **66**, **232** etc., of all places in the accumulator, for preventing unintentional rotation of the driving wheels. Each arm of the frame **265** is equipped with a spring **271**, as shown for the arm **266** in Figs. 3, 4 and 17 which is secured to the adjacent side plate **159** or **160** by a pin **272**. The springs turn the frame **265** clockwise and hold the profiled rod **269** between the teeth **171**.

The three-armed lever **250** and the parts **253** and **255** which are cooperating with it, are also arranged at the left-hand side of the thousandths place in the accumulator **2**.

(7) *The operation of the mechanisms when total taking in the column totalizer and transferring the value to the accumulator additively*

The operation of the parts allotted to the individual calculating places of the accumulator **2** is the same in each place, and so only the operation at the units place of the accumulator **2** will be described in detail.

In their initial positions, the locking levers **240** and the locking wheel levers **77**, through their locking wheels **227**, **241**, etc., prevent rotation of the allotted driving wheels **232**, **244** etc., in the same manner as described for the locking of the wheels **82**, **107** etc. of the column totalizer **1** in section (3).

When it is desired to withdraw a value which has been introduced into the units place of the column totalizer **1**, from the totalizer by total taking, and, at the same time, to transfer this value additively into the accumulator **2**, the manipulating handle **3**—whose arrangement and operation will be described in section (14)—is thrown over from the uncoupling position in Figs. 2 and 14 into the coupling position in Figs. 3 and 15. The accumulator **2** is swung clockwise about the shaft **158** until the lugs **167** and **165** on the side plates **159** and **160** of the accumulator **2** bear on the abutments **168** and **166** on the side plates **13** and **14** of the column totalizer **1**. The driving wheels **66**, **232** etc. of the calculating places in the accumulator **2** now mesh with the corresponding transmission wheels **45**, **273** at the corresponding calculating places in the column totalizer **1**.

When the column totalizer **1** moves into active position with its units place, the locking lever **114**, as described in section (3), is turned anti-clockwise by the releasing finger **19** about the bar **15**, as shown in Fig. 3, and its tooth **274** acts on the tooth **275** at the lower end of the locking wheel lever **240** at the units place of the accumulator **2**, swinging the lever **240** clockwise about the shaft **191** against its spring **276**. The incline **258** at the back of the lever turns the flap **203** anti-clockwise and the front edge **205** of the flap **203** engages in the recess **277** in the lever **240** while at the same time it engages the lugs **207** or **221** of the other locking levers **189** and locking wheel levers **77** which are in their normal positions, and are prevented against unintentional turning. At the same time, through the noses **200** and **34** and **218** and **76**, the locking and locking wheel levers **17**, **71** in the column totalizer **1** are held against unintentional movement, that is, while an operation is performed in the units places of the column totalizer and the accumulator, all other places are locked against operation.

When the flap **203** is turned, the arms **254** of its members **255** act on the ends **251** of the three-armed levers **250** which, as viewed from the right and the front of the column totalizer **1** are arranged at the left of the fourth and eighth places of the accumulator **2**, and turn such levers clockwise about the shaft **191** against their springs **257**. In Fig. 5 only one of said levers **250** is illustrated. The teeth **260** of the levers **250** clear the teeth of the driving wheels **262** and **278** at the fifth and ninth places.

A short time before the three-armed levers **250** have completed their swinging movement, their teeth **263**, through the stay **264**, turn the locking frame **265** anti-clockwise about the shaft **270** against its springs **271**. The profiled rod **269** is now retracted from the teeth **171**, **231** etc. of the

driving wheels **66**, **232** etc. of the accumulator **2** with its rib **268**, and releases the wheels.

As the locking wheel lever **240** of the units place in the accumulator **2** moves clockwise about the shaft **191**, the Maltese wheel portion **245** of its locking and tens transfer wheel **241** clears the flange **246** of the driving wheel **236** of the comma place, and its teeth **242** clear the teeth **243** of the driving **244** in the units place. The driving wheel **244** and its train **279**, **280** and **6** are ready for the reception of a value.

When the locking wheel lever **114** of the units place in the column totalizer **1** turns anti-clockwise, its fork **126** turns the allotted coupling arm **129** clockwise about the boss **138** of the spur gear **130**, and the wide coupling gear **131**, as described in section (3), connects the pair of transmission wheels **132** and **133** allotted to the units place.

The value which has been introduced in the units place of the column totalizer **1** is now withdrawn by total taking, as described in section (5) and, as the driving wheel **12** is rotated in the direction of the arrow **281**, the train of gears **111**, **136**, **130**, **137**, and the number roller **10** of the units place rotate in directions **155** indicated in Fig. 3 until one of the zero setting teeth **154** of the flange **151** engages the zero stop **57**. In this position the number roller **10** of the units place displays "0."

When the spur gear **130** of the units place is turned backwards in the direction of the arrow **155** in Fig. 3, the transmission wheel **132** is also turned anti-clockwise, and the coupling wheel **131** which meshes with it is turned clockwise and turns the other wheel **133** anti-clockwise. The wheel **133**, through its teeth turns the driving wheel **244** of the accumulator in the direction of the arrow **282**. The driving wheel **244** now transfers the total value on the corresponding number wheel **6** through pinions **279** and **280** which number wheel turns in additive or clockwise direction and indicates the total withdrawn from the column totalizer **1**.

The releasing finger **19** now releases the locking lever **114** on the units place in the column totalizer **1** and the lever returns into its initial position, as shown in Fig. 2. At the same time, the nose **274** of the locking lever **114** releases the nose **275** at the lower end of the locking wheel lever **240** at the units place in the accumulator **2** whose spring **276** returns it into its normal position, Fig. 2, with its abutment bearing against the screw **284** in the bar **196**. The incline **258** of the returning locking wheel lever **240** releases the flap **203**, and by the cooperation of the arms **254** of the members **255** on the flap **203**, and the teeth **251** of the three-armed levers **250**, the latter become free to return into their normal positions, Fig. 2 and their teeth **263** clear the stay **264** of the locking frame **265** which is now returned into its normal position by the springs **271** turning it clockwise about its shaft **270**, and the rib **268** of the rod **269** engages between the teeth of the driving wheels **66**, **232** etc. and locks them, as shown in Fig. 2.

The teeth **263** of the three-armed levers **250** are so positioned with respect to the stay **264** that the rib **268** of the rod **269** in the locking frame **265** is already between the teeth **171**, **231** etc. before the coupling gear **131** is moved clear of the transmission wheels **132**, **133** owing to the return of the locking lever **114** in the units place of the column totalizer **1**. This prevents overthrowing of the train **244**, **265**, **279**, **280** after the throwing out of the coupling wheel **231**.

In the locking position of the frame **265**, Fig. 2, the rib **268** of its rod **269** exactly aligns the number rollers **6** displayed through the slot **5** in Fig. 1.

When the flap **203** has returned into its initial position its inner side again engages the inclines **258**, **202** and **220** of the levers **189**, **240** and **77** in the places of the accumulator, and its front edge **205** leaves the recess **277** in the locking wheel lever **240** at the units place and recedes from the edges **207** and **221** of the parts **208** and **222** of the locking and locking wheel levers **189** and **77** at the other calculating places, releasing the said levers, as shown in Fig. 2.

When the three-armed levers **250** have returned into their normal positions as shown in Fig. 2, their teeth **260** again engage between the teeth of the driving wheels **262**, etc.

When the locking wheel lever **240** at the units place of the accumulator **2** has returned into its initial position Fig. 2, the teeth **242** of its locking wheel **241** again come into mesh with the teeth **243** of the driving wheel **244** of the units place and its Maltese wheel **245** again engages the flange **246** of the driving wheel **236** in the comma place, and now all parts of the unit place in the accumulator **2** have returned into the initial positions, shown in Figs. 2 and 5.

When it is desired that when total taking from the column totalizer **1** the value should be transferred to the accumulator **2** subtractively, the handle **3** is thrown into the position illustrated in Fig. 4 to engage the train of gears **285** in the accumulator **2** with the transmission gears **133** of the column totalizer **1**. In this case, the train **244**, **279** and **280** of the units place is rotated against the arrows **282** in Fig. 3. The operation need not be described.

(8) *The tens transfer in the accumulator*

The operations which are performed during a tens transfer in the accumulator **2**, are substantially similar to the operations described with respect to the column totalizer **1** in section (4), and will therefore not be described.

It should be noted, however, that a rotation of the driving wheel **262** in the tens place in combination, for instance, with a tens transfer from the units to the tens place in the accumulator **2**, and the corresponding rotation of the mating transmission wheel **286** (Fig. 7) at the tens place of the column totalizer **1** does not influence the tens calculating place in the column totalizer since the not illustrated locking wheel lever of the tens place which corresponds the lever **71** is not swung by the releasing finger **19**, and the coupling gear of the tens place is not coupled with the transmission wheels **287**, **286** of the tens place, and the transmission gear **287** turns idly with respect to transmission gear **286**. In order to obtain an effective tens transfer in the accumulator **2**, it was necessary to provide a pair of transmission wheels **44**, **45** and **273**, **288** etc. for each driving wheel **66**, **232** etc.

(9) *The additive introduction of a value into the column totalizer and the additive transfer to the accumulator*

When an accounting problem requires the additive introduction of a value into the column totalizer **1** and an additive transfer of this value into the accumulator **2**, the manipulating lever **3** is moved into the position illustrated in Fig. 16. The gears **176**, **233**, **265** etc. in the accumulator **2** engage with the transmission gears **45**, **273** etc.

in the column totalizer 1 in a manner which will be described in section 12. Since the operations in the column totalizer 1 have already been described in section 3, this will not be repeated here.

When the locking lever 114 of the units place in the column totalizer 1 is swung, the parts 107, 129, 131, 67, 101 and 98 operated by it are moved into the active position shown in Fig. 4. At the same time, the nose 274 of the lever 114 acts on the nose 275 of the locking wheel lever 240 allotted to the units place of the accumulator 2, so that the lever 240 together with the cooperating parts 263, 255, 259, frame 265, and locking wheel 241 are moved into the positions shown in Fig. 4.

When the main driving wheel 111 of the units place in the column totalizer 1 is rotated in the direction of the arrow 135 in Fig. 4, in conformity with the value to be introduced the wheel transfers the value to the corresponding number roller 10 through gears 136, 130 and 137. The number roller is now rotated in the direction of the arrow 135 and indicates the value. When the spur gear 130 at the units place rotates in the direction of the arrow 135, the transmission gear 132, and through the coupling gear 131, the transmission gear 133, are rotated clockwise. The rotation of the transmission gear 133 is transmitted to the spur gear 285 of the units place in the accumulator 2. The spur gear 285 rotates in the direction of the arrow 289 and rotates the driving wheel 244 and the other train 279, 280 and 6 in the direction of the arrows 282 in conformity with the value to be introduced, whereby this value is transmitted positively to the corresponding number roller 6 at the units place in the accumulator 2.

(10) The introduction of a value into the column totalizer additively and the subtractive transfer to the accumulator

If the accounting problem requires the additive introduction of a value into the column totalizer 1 and subtractive transfer to the accumulator 2, the manipulating lever 3 is moved into the position shown in Fig. 15 for connecting the driving wheels 66, 232, 244, etc. in the accumulator 2 to the transmission gears 45, 273 etc. of the column totalizer 1, Figs. 3 and 7. When now the train 111, 136, 130, 131, 137, 10 for example of the column totalizer 1 is rotated in conformity with the value to be introduced, in the direction 135 in Fig. 3, the transmission gear 133 which is rotated anti-clockwise by 132 and 131, the driving wheel 244 which meshes with 133, and by the wheel 244, the train 279, 280 and 6 of the accumulator 2 are rotated against the arrows 282 and the value is subtractively transferred to the number roller 6.

(11) The cancellation of the accumulator

The cancellation of a value which has been indicated by the number roller 6 of the accumulator 2, requires backward transmission of this value into the column totalizer 1 after this has been set to zero by total taking.

The manipulation lever 3 is moved into the position in Fig. 15, whereby the driving wheels 66, 232, 244 etc. of the accumulator 2 are connected to the transmission gears 45, 273 etc. of the column totalizer 1.

For instance, if the number roller 6 of the units place indicates the value "3" in the accumulator 2, this value "3" is cancelled as follows:

When the units place of the column totalizer 1 has moved into active position, the calculating key for the value "3"—not shown—is depressed for introducing the value "3", the units places of the column totalizer 1 and of the accumulator 2 are unlocked by the levers 114 and 240, and the train of gears 111, 136, 151, 130, 137 and 10 of the unit place in the column totalizer 1 is rotated in additive direction three times, as shown by the arrows 135 in Fig. 3, the spur gear 130 transmitting the value "3" to the transmission gear 133 through 132 and 131. The transmission gear 133 now rotates clockwise and rotates the train 244, 279, 280 and 6 at the units place in the accumulator 2 for three units against the arrows 282. When this rotation has been completed, the number roller 6 of the units place in the accumulator 2 again displays a "0", while the number roller 10 of the units place in the column totalizer 1 displays "3". This value "3" in the column totalizer 1 is canceled by total taking in the column totalizer 1, after the manipulating lever 3 has returned the accumulator 2 into its initial position, as shown in Figs. 2 and 14.

(12) The arrangement of the coupling and locking means for the accumulator

A headed screw 290, Figs. 14 to 17, is inserted in the left-hand side plate 14 of the column totalizer 1 as the pivot for the left-hand arm 293 of the manipulating lever 3, a bore 292 in the arm being seated on the shank 291 of the headed screw 290, as shown in Fig. 17. A blade spring 295 is riveted to the arm 293 at 294 and its free end supports a pin 296 sliding in a hole 297 in the arm 293. The inner end of the pin 296 which projects from the hole 297 in the arm 293 is hemispherical for cooperation with three hemispherical depressions 298, 299, and 300 in the left-hand side plate 160 of the accumulator 2, holding the manipulating arm in one of the three positions.

The lower end of the arm 293 is made with a camplate 301 whose front edge 302 is curved. In the normal position of the manipulating lever 3, Figs. 2 and 14, the curved front edge 302 bears below the end 179 of the pinion shaft 177 which it will be remembered, is mounted to slide in the arcuate slots 180 and 181 in the side plates of the accumulator 2. The pinion shaft 177 is now held against downward movement. At the lower end of the front edge 302, a semicircular seat 304 is formed by the upper edge of a hook 303 in continuation of the front edge 302 which engages below the end 179 of the shaft 177 when the manipulating lever 3 is in the position shown in Fig. 15. A slot 305 is made at the upper end of the front edge 302 in which the end 179 is free to slide when the manipulating lever 3 is in the position shown in Fig. 16.

An angular cam slot 307 is made in the rear portion 306 of the camplate 301, and into this projects a pin 308 secured in the left-hand side plate 160 of the accumulator 2. In the position according to Fig. 15, this pin is in the straight part 310 of the cam slot, and in the position illustrated in Fig. 16 it is in the curved part 309. By the cooperation of the pin 308 and the cam slot 307, a definite position is given to the accumulator 2 which swings about the shaft 158 on the column totalizer 1, for all positions of the manipulating lever 3. A recess 311 is made in the lower edge of the angular slot 307 in its curved portion 309. In the initial position of the manipulating lever 3, as shown in Figs. 1, 14 and 17, an abutment 312, projecting from the left-hand side plate 160 of the accumulator 2 engages in

the recess 311. The abutment 312 is the left-hand end of a locking rack 313, as best seen in Fig. 18. The edge 314 of the abutment is curved and, upon corresponding movement of the manipulating lever 3 can cooperate with the lower edge 315 of the curved part of the angular slot 307, or with a hook 316 at the side of the recess 311.

The locking rack 313 is guided in a slot in the left-hand side plate 160 by its abutment 312, and in a similar slot in the right hand side plate 159 by an extension 317. A spring 318 which is attached to a pin 319 in the rack 313 at one end, and to a pin 320 in the side plate 160 at the other pulls the rack in the direction of the arrow 321 and a lug 322 on the rack bears against the inner side of the plate 160 to define the normal position of the rack. In this position, the ten teeth 323 of the rack engage between the teeth of the driving wheels 66, 232 etc. in the accumulator 2 and prevent unintentional rotation.

The right-hand arm 324 of the manipulating lever 3 is made exactly like the left-hand one 293, but its cam slot is without the recess 311.

(13) The operation of the coupling and locking means for total taking from the column totalizer and additive transfer to the accumulator

For this operation, the manipulating lever 3 is placed into the position shown in Figs. 3 and 15. The arms 293 and 324 turn clockwise about their headed screws 290. The pins 296, 325 leave the depressions 298, 327 in the side plates 159 and 160. At first, the curved parts 309, 328 of the camslots 307, 329 move idly past the pins 308, 330 but then their edges 331, 332 engage the pins and the accumulator 2 is swung about the shaft 158 clockwise until the lugs 167 and 165 engage the abutments 159 and 160. In this position, the pins 296, 325 engage in the depressions 299, 334 in the side plates 159 and 160. In this position of the accumulator, the teeth of the driving wheels 66, 232 etc. in the accumulator 2 engage with the transmission gears 45, 273 etc. in the column totalizer 1. The ends 178 and 179 of the shaft 177 are held at the upper ends of their arcuate slots 180 and 181 by the semicircular seats 304.

When the manipulating lever 3 is moved anti-clockwise into the position in Figs. 14 and 17, the hook 316 of the arm 293 pushes the abutment 312 of the rack 313 against the arrow 321 in Fig. 18, so that its teeth 313 clear the teeth of the driving wheels 66, 232 etc. and a gap 337 in the rack is presented to each row of the teeth of said driving wheels 66, 232 etc. The driving wheels are now free to rotate when a value is introduced.

When it is desired to uncouple the accumulator 2 from the column totalizer 1, the manipulating lever 3 is returned into the position shown in Figs. 2 and 14. First, the pins 296, 325 leave the depressions 299, 334 in the side plates 159 and 160 and the edges 338, 339 of the camslots 307, 329 in both arms engage the pins 308, 330 and return the accumulator 2 into its normal position by swinging it anti-clockwise about the shaft 158 and the pins 308, 330 are now again in the curved parts 309, 328 of the camslots 307, 329. At the same time, the hook 316 of the arm 293 at the left releases the rack 313 and the spring 318 again forces the lug 322 of the rack against the inner side of the side plate 160. The teeth 323 of the rack again lock the driving wheels 66, 232 etc. through their teeth. The pins 296, 325 engage in the depressions 298, 327 and the teeth of the driving wheels 66, 232 etc. in the accumulator clear the transmission gears 45, 273 etc. of the column totalizer 1.

(14) The operation of the coupling and locking means for total taking from the column totalizer and subtractive transfer to the accumulator

For this operation, the manipulating handle 3 is moved into the position in Fig. 16. The pins 296, 325 leave the depressions 298, 327 and the curved edges 302, 335 of both arms 293 and 324 clear the ends 178 and 179 of the shaft 177, until the upper edges 341 of the slots 305 act on the shaft 177 whose ends 178 and 179 now descend in the direction of the arrow 343 in Fig. 16. As the shaft 177 descends the pinions 176, 233 etc. of the individual places which are free to rotate on the shaft, roll on the teeth of the driving wheels 66, 232 etc. and, when the manipulating lever 3 has completed its stroke, mesh with the transmission gears 45, 273 etc. in the column totalizer 1.

As the manipulating handle 3 moves into the position in Fig. 16, the curved portion 309, 328 of the camslots 307, 329 slide idly past the pins 308, 330 in both side plates 159 and 160. The hook 315 of the arm 293 pushes the rack 313 against the arrow 321 and its teeth 323 clear the teeth of the driving wheels 66, 232 etc. The pins 296, 325 engage in the depression 300, 344 of the side plates 159 and 160.

When the manipulating lever 3 is returned into the normal position in Fig. 14, the edges 345, 346 of the slots 305, 340 raise the shaft 177 against the arrow 343 so that its pinions 176, 233 etc. are moved clear of the transmission gears 45, 273 etc. roll on the teeth of the driving wheel 66, 232 etc. and return into their normal positions. The curved edges 302, 335 of the arms 293 and 324 again engage the ends 178 and 179 of the shaft 177 and hold it in its normal position. The hook 315 of the left-hand arm 293 releases the rack 313 which, returning in the direction 321, locks the driving wheels 66, 232 etc. The pins 296, 325 engage in the depressions 298, 327 in the side plates 159 and 160.

If it is desired to transfer additively to the accumulator 2 a value additively introduced into the column totalizer 1, the manipulating lever 3 is moved into the position according to Figs. 4 and 16, and the operations which have been described above for negative transfer are repeated.

On the other hand, if it is desired to transfer subtractively to the accumulator 2 a value which has been introduced additively into the column totalizer 1, the manipulating handle 3 is moved into the position shown in Figs. 3 and 15, and the operations described in section 13 are performed.

(15) The suspension and securing means for the double totalizer

The side plates 13 and 14 of the column totalizer 1 are equipped with hooks 350 and 349, respectively, as best seen in Fig. 19, at their lower rear ends which engage the lower edge 351 of the dove-tailed rail 11. For suspending the column totalizer 1 from the rail, the following arrangement is provided.

A suspension bar 352 which is shown partly broken away in Fig. 19, and has a hook-shaped ridge 357 at its free end for engaging the upper edge 358 of the rail 11, as shown on larger scale in Fig. 2, is mounted to swing between the side plates 13 and 14 of the column totalizer 1 by means of trunnions 353 and 354 in holes 355 and 356 in the respective side plates 13 and 14.

For securing the column totalizer 1 against

lateral displacement on the rail 11, a catch 359 is mounted on the trunnion 353 and rigidly connected to the suspension bar 352. The rear end of the catch is forked, forming a hook 360 which bears on the upper edge 358 of the rail 11 and a tooth 361 for engaging between the teeth of the rack 347 to secure the column totalizer 1 against lateral displacement. A pin 362 extends between the bar 353 and the catch 359 on which is attached a spring 364 whose lower end is secured to a pin 363 in the right hand side plate 13. This spring tends to turn the bar 253 clockwise, forcing the ridge 357 of the bar and the hook 360 of the catch 359 against the upper edge 358 of the rail 11.

A cam 366, Fig. 20, at the lever edge of the catch 359 is provided for cooperation with a pin 367 of a locking arm 368 which extends through an arcuate slot 369 in the right-hand side plate 13. The locking arm is fulcrumed about a headed screw 370 in the side plate 13 and its movement is limited by the ends 371 and 372 of the slot 369.

A lug 373 which extends upwardly from the front end of the catch 359 is arranged for cooperation with a lug 375 of a bellcrank 374 which is mounted to turn about the shaft 158. A torsion spring 377 is wound about the shaft 158 and its longer arm 378 engages in a recess 379 in the transverse stay 163 of the accumulator 2, as best seen in Fig. 2. This spring tends to turn the bellcrank 376 anti-clockwise about the shaft 158 and forces the lug 375 against the lug 373 of the catch 359. The strength of the spring is just sufficient for holding the two lugs engaged, but it cannot turn the catch 359 anti-clockwise against the spring 364.

A tooth 382 on the bellcrank 376 is arranged for cooperation with the flap 203, and a handle 383 on the bellcrank projects through a slot in the cover plate 4 of the accumulator.

(16) The operation of the suspension and securing means

When it is desired to remove the double totalizer from the rail 11, the locking lever 368 is turned clockwise from the locking position in Fig. 21 into the unlocking position in Fig. 20 in which the pin 367 is against the end 372 of the slot 359. The pin now clears the lower edge 265 of the catch 359. By means of the handle 384, the bellcrank 376 is now turned anti-clockwise and its lug 375, through the lug 373 on whose upper edge 374 it acts, turns the catch 359 and the suspension bar 352 anti-clockwise about the trunnions 353 and 354. The ridge 357 of the bar 352 and the hook 360 now clear the upper edge of the suspension rail 11, and the tooth 361 of the catch 359 clears the rack 347, so that the double totalizer can now be removed.

When the handle 384 is released, the bar 352, the catch 359, and the bellcrank 376 are returned into their normal positions by the spring 364, and the tooth 382 of the bellcrank 376 turns the flap 203 anti-clockwise about its trunnions 204 and its edge 305 is placed against the edges 207, 221, 258 etc. of the levers 189, 77 etc. in the totalizer 2, so that unintentional turning of the wheels in the column totalizer 1 and the accumulator 2 is prevented.

(17) Placing the double totalizer on the suspension rail

When it is desired to place the double totalizer on the suspension rail 11, the handle 384 is pressed, the column totalizer 1 is placed on the rail, and the handle is released. Spring 364 now turns the bar 352 and the catch 359 clockwise, the ridge 357 and the hook 360 again engage the upper edge of the rail 11, and the tooth 361 returns between the teeth of the rack 347. The bellcrank 376 returns into the position shown in Fig. 20. The locking arm 368 is now turned anti-clockwise into its locking position, Fig. 21, in which its pin 367 bears against the end 371 of the slot 369. The pin 367 raises the catch 359 by its cam 366 and the upper edge 358 of the rail 11 is firmly engaged by the ridge 357 and the hook 360.

(18) A modification

It is not necessary that the totalizer 2 which is preferably an accumulator, should be pivoted to the column totalizer 1, as has been described. The totalizer or accumulator 2 may be arranged independently on the suspension rail 11.

Or it might be arranged for vertical displacement, and be coupled with one of a set of cross totalizers 385 as shown in Fig. 22. The coupled cross totalizer 385 now replaces the column totalizer 1 of the previously described system.

When the accumulator 2 has been placed in position above the cross totalizer 385, this is moved along on its slide 386 by the idle totalizer 387 in time with the accumulator 2.

Obviously, in this case the headed screws 290 the manipulating lever 3 is fulcrumed about, must be arranged on the accumulator 2, and not at the cross totalizer 385. The accumulator must, however, be able to occupy the positions illustrated in Figs. 2 to 4.

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Serial No.
251,634
10 Sheets-Sheet 1

Fig. 1

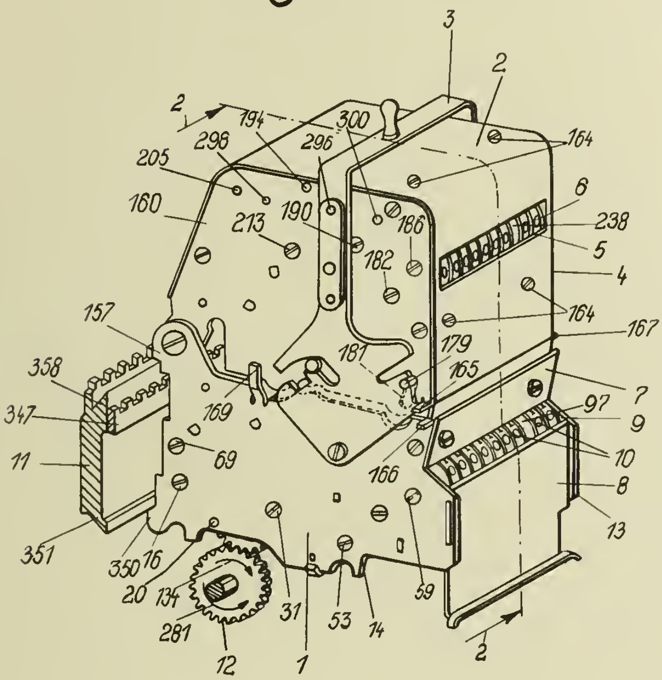

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Fig. 2

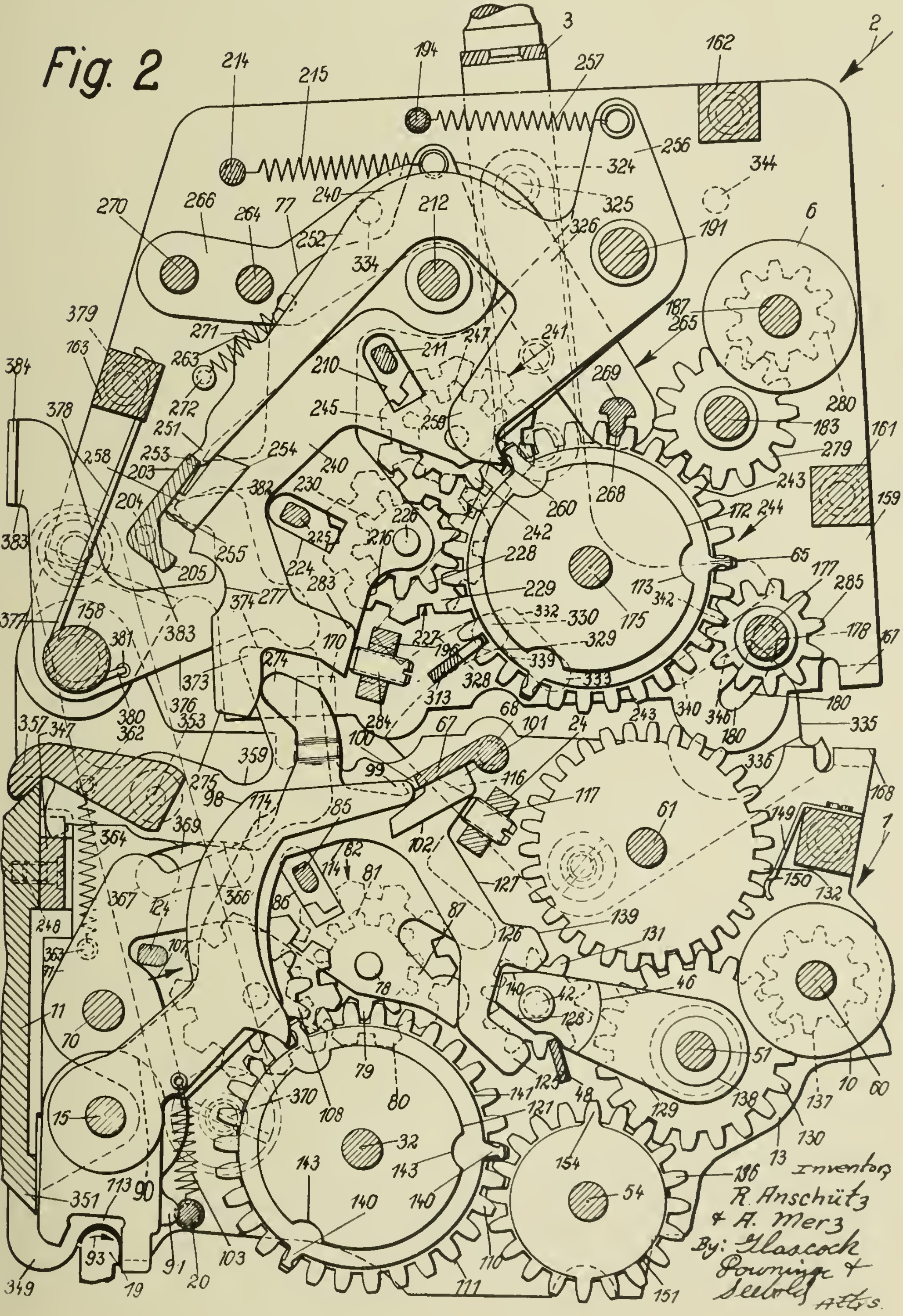

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Fig. 3

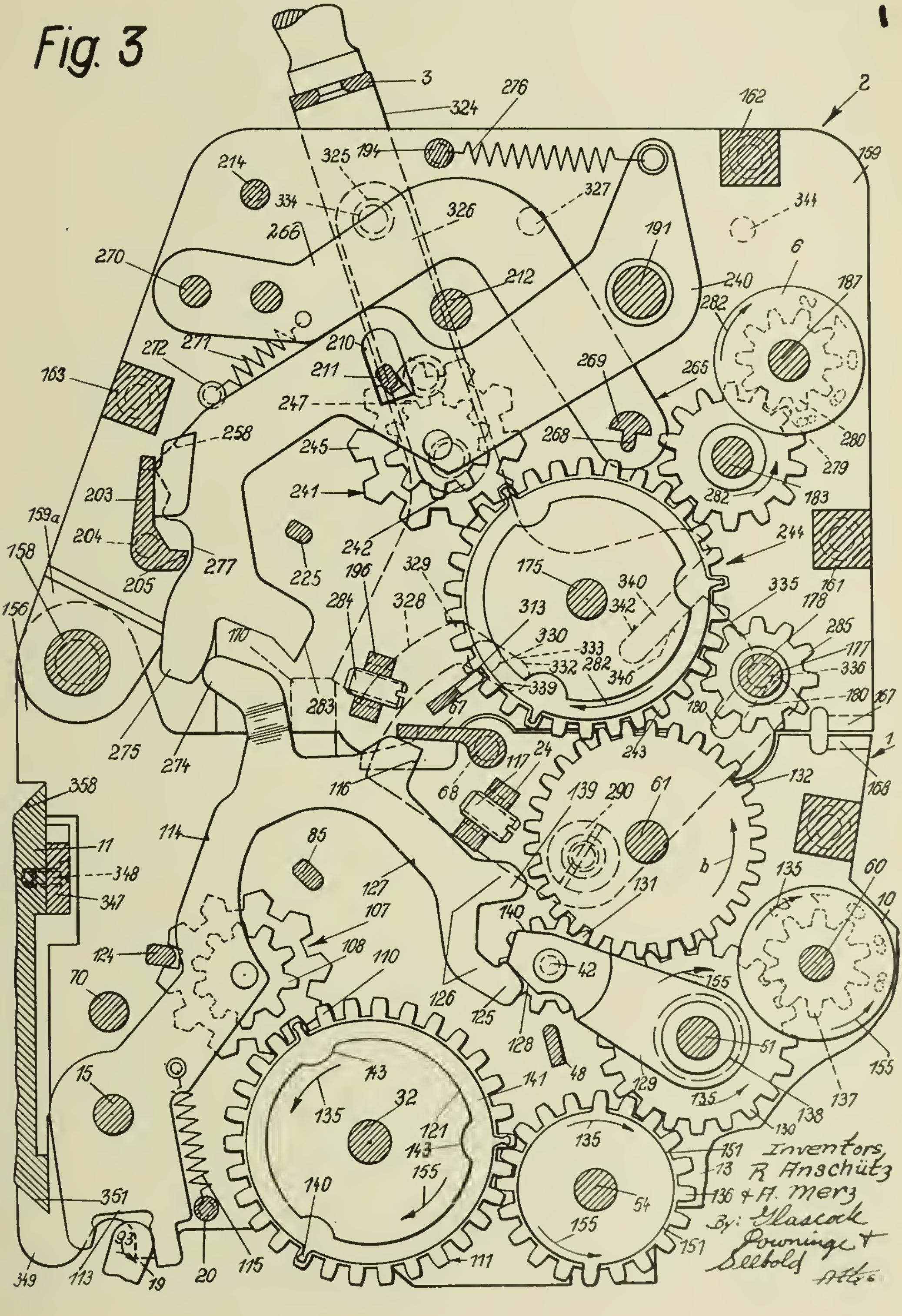

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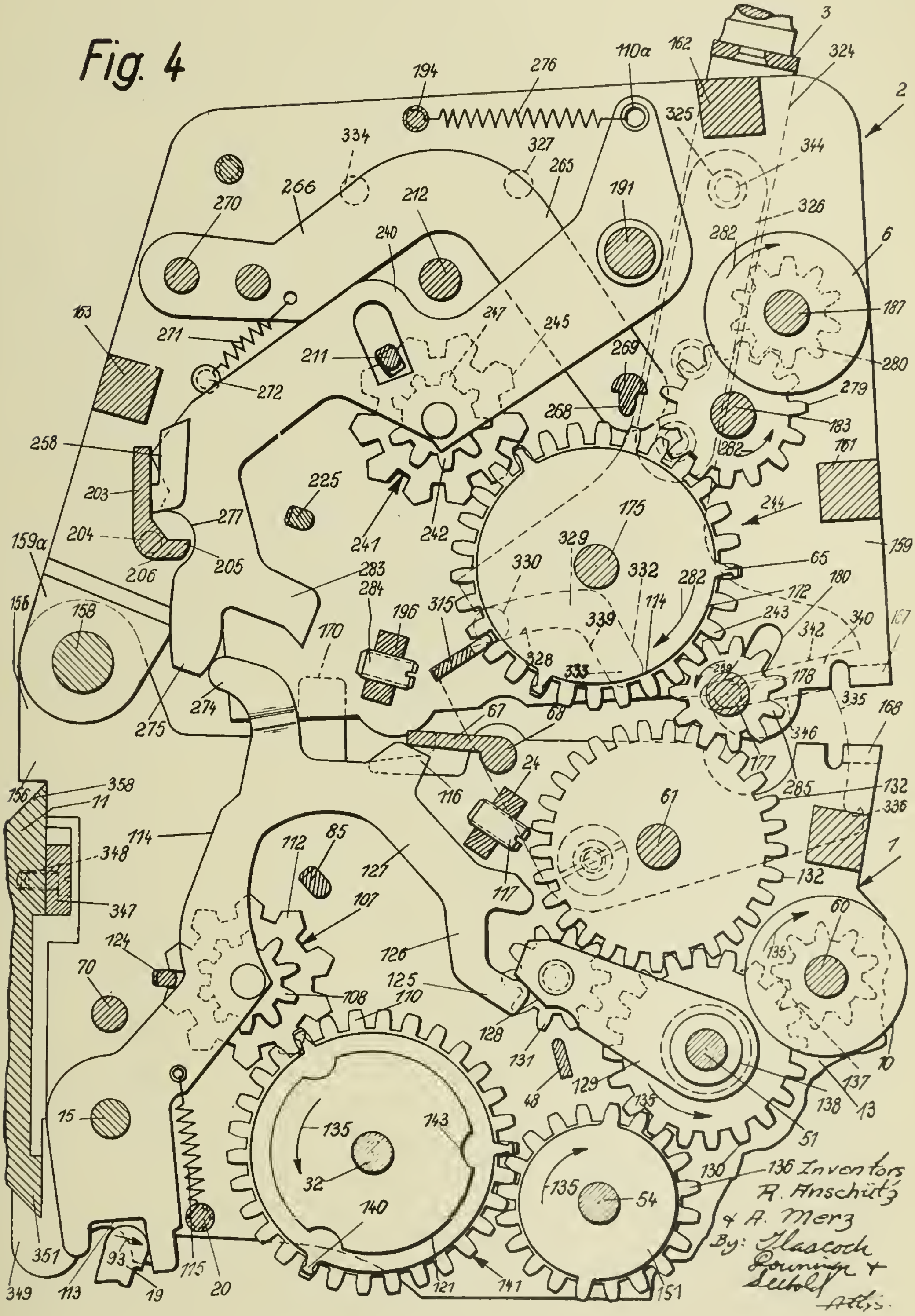
Fig. 4



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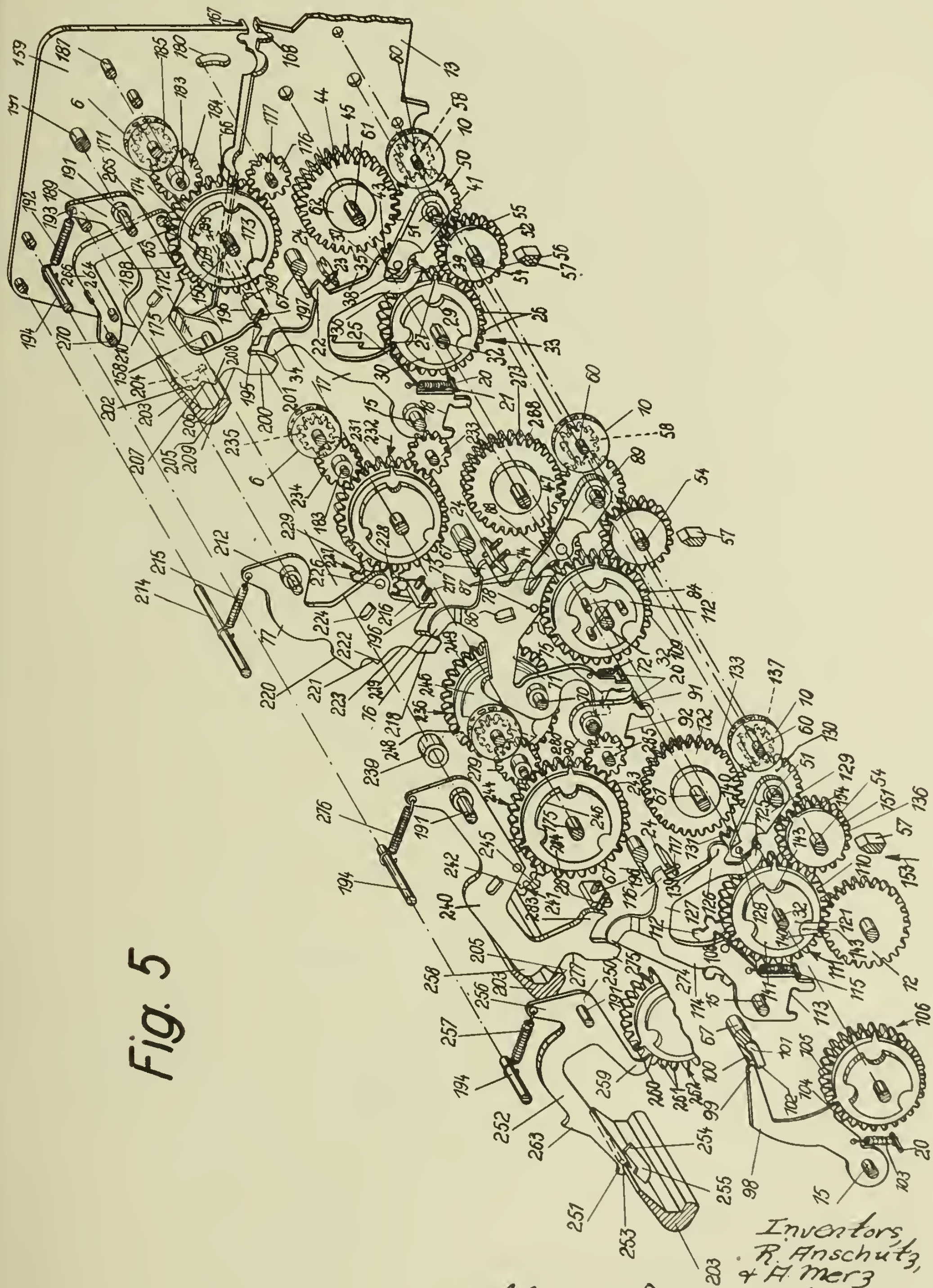

Fig. 5

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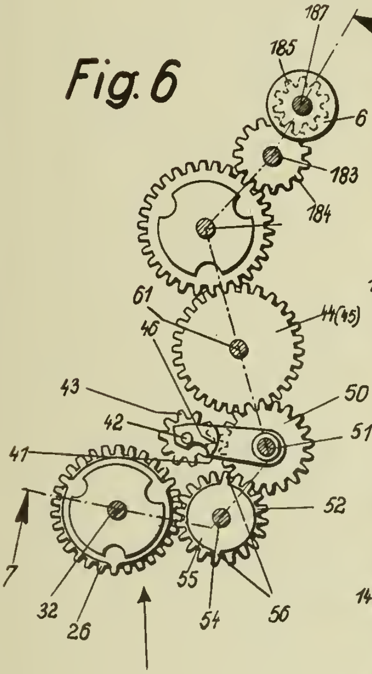
Fig. 6



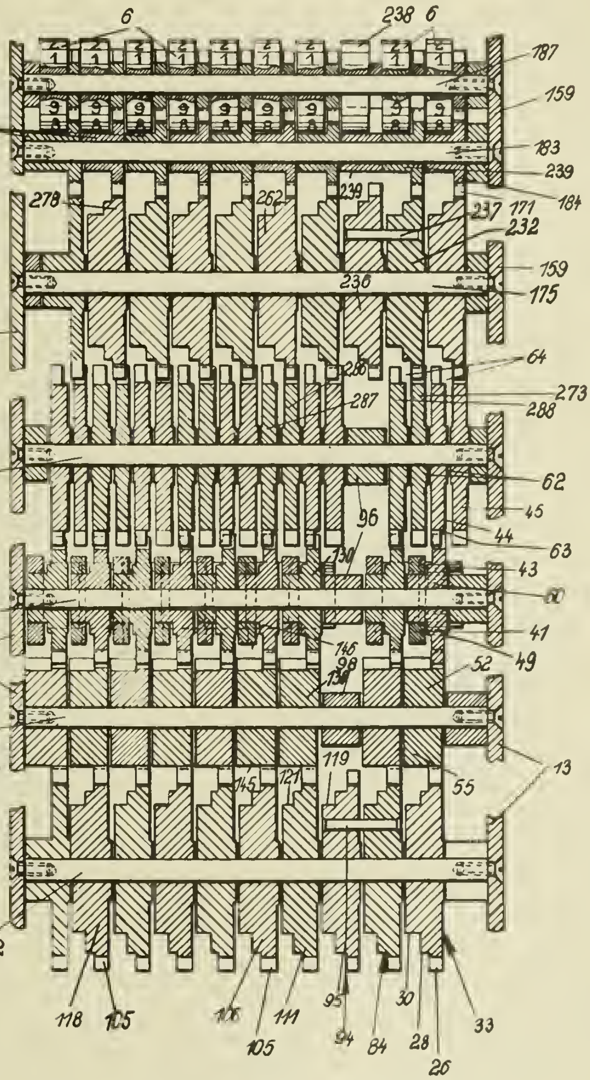


Fig. 7

Fig 8

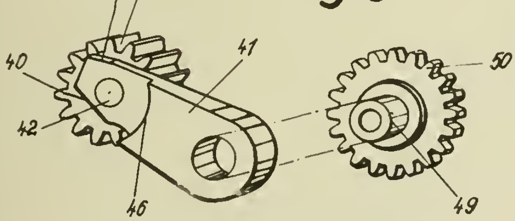


Fig. 9

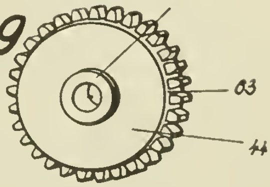


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Fig. 10

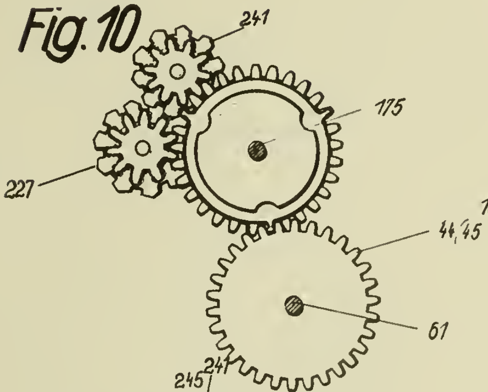
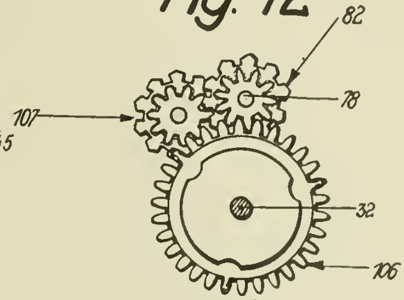


Fig. 12



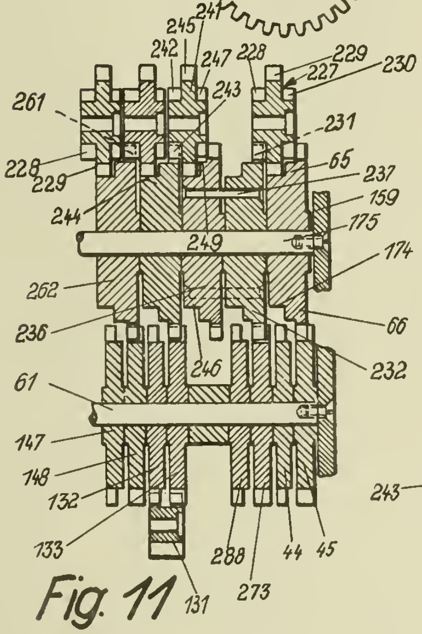
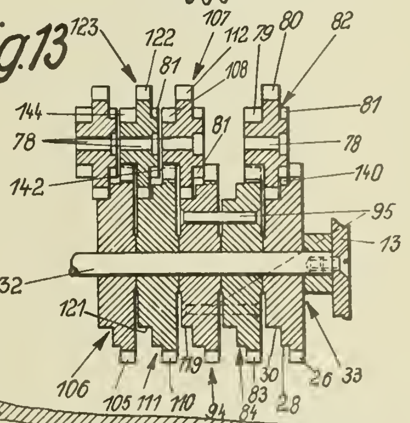


Fig. 11

Fig. 13



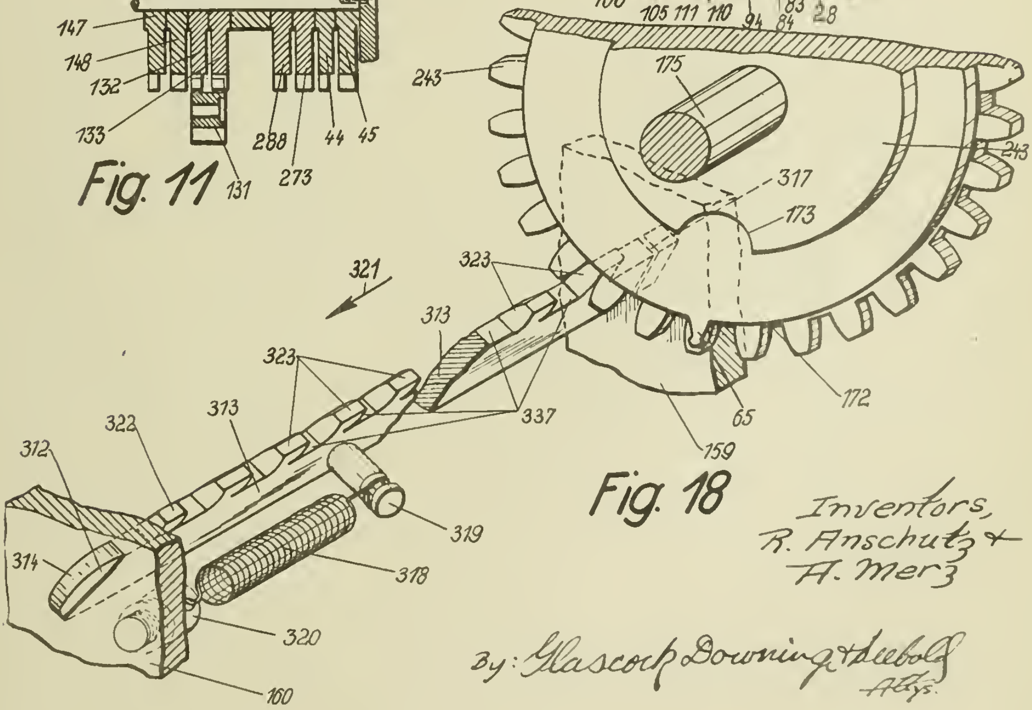


Fig. 18

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Fig. 14

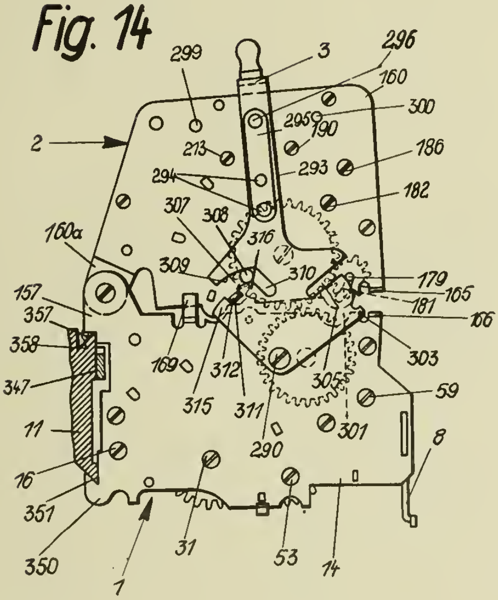

Fig. 15

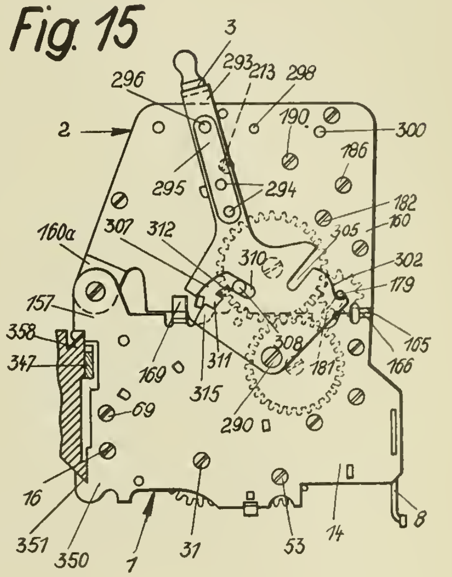

Fig. 16

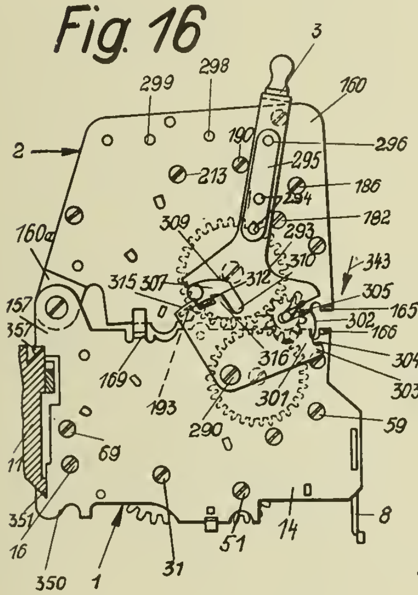

Fig. 17

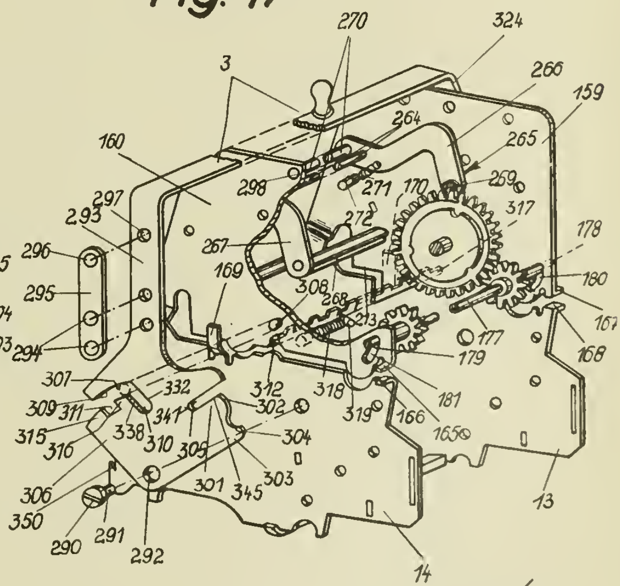

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Fig. 19

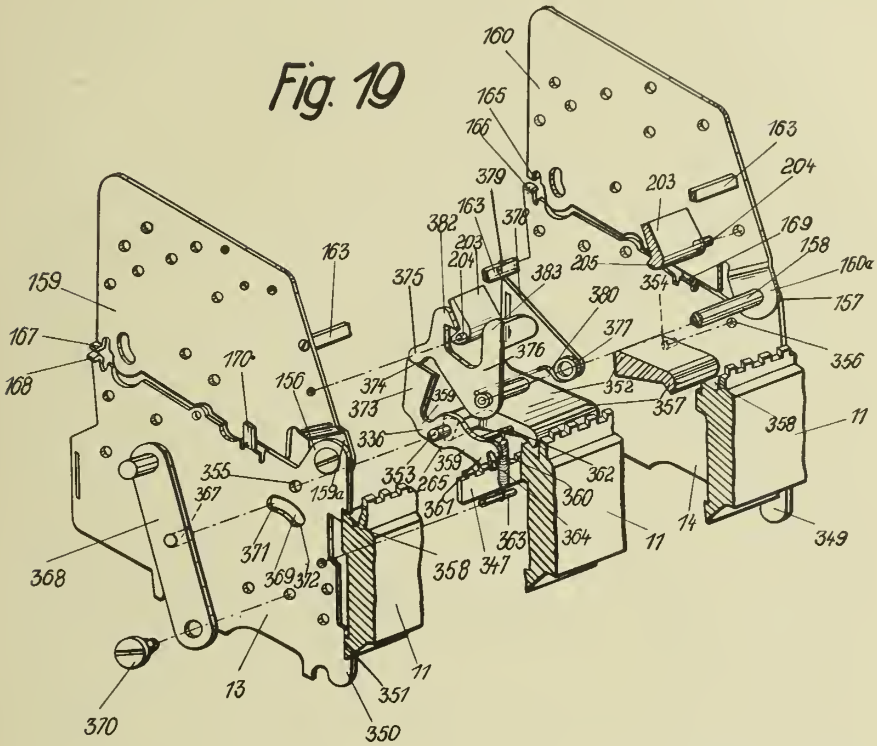

Fig. 20

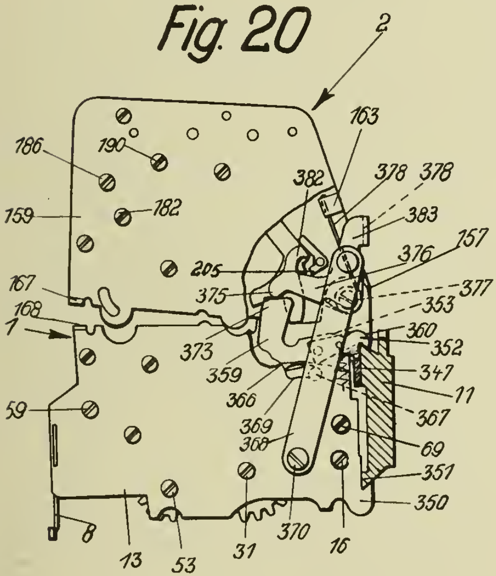

Fig. 21

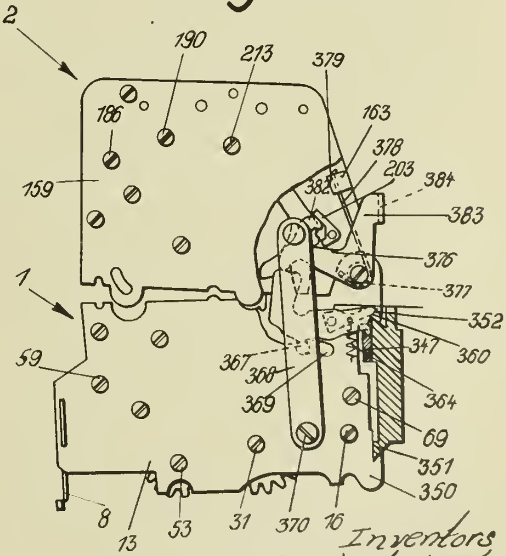

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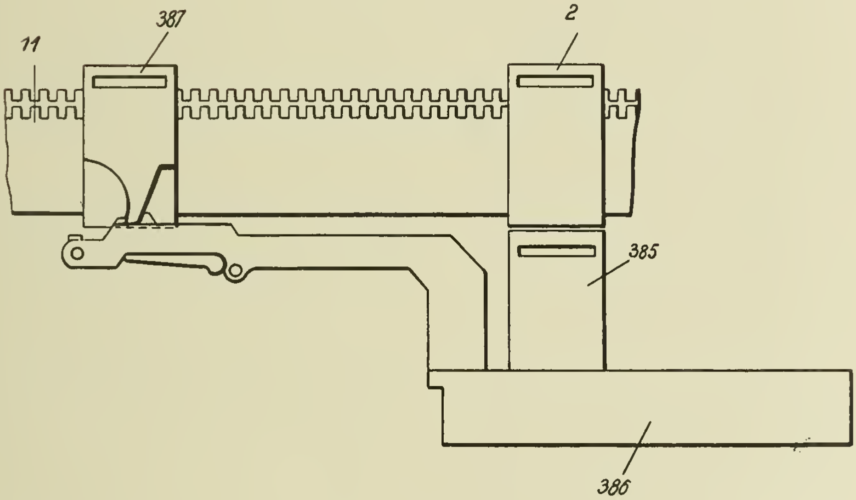
Fig. 22



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ALIEN PROPERTY CUSTODIAN

BRAKE FOR AIRCRAFT

Claude Dornier, Friedrichshafen A. B., Germany; vested in the Alien Property Custodian

Application filed January 23, 1939

The present invention relates to air brakes for aircraft, particularly to aeroplanes having a fuselage, an air brake attached thereto and a tail unit which extends laterally from said fuselage and air brake.

It has been proposed to provide the fuselage of aeroplanes with members of high air resistance and locate said members in the rear of the tail unit in order to avoid vibrations. In such cases the fuselage usually must be made longer than is desirable.

According to the present invention the air brake is positioned between the fins and rudders constituting the tail unit. It is preferably made of members of high air resistance which project upward and downward from the fuselage. With this construction vibrations are eliminated and no extraordinarily long fuselage is needed.

Further and other objects of the present invention will be hereinafter set forth in the accompanying specification and shown in the drawings, which, by way of illustration, show what I now consider to be a preferred embodiment of my invention.

In the drawings two embodiments of the present application are shown.

Figure 1 is an isometric showing of the rear part of an aeroplane according to the present invention.

Figure 2 is an isometric showing of the rear part of a modified design of an aeroplane according to the present invention.

Like numerals indicate like parts in all figures of the drawings.

Referring more specifically to Fig. 1 of the drawings, numeral **1** designates the fuselage of the aeroplane; **2** and **3** are lateral tail unit fins and **4** and **5** lateral tail unit rudders. Between the fins and rudders air brake flaps **6** and **7** are provided which protrude from the rear end of the fuselage when in operating position and which can be retracted into openings **10** of the skin of the fuselage to form part of the fuselage surface and cause no air resistance when no braking action is required. The flaps **6** and **7** are provided with slot openings **11** to reduce the air resistance to a desired value.

The embodiment of my invention, shown in Fig. 2, is substantially like that illustrated in Fig. 1. Instead of slots **11** the flaps **8** and **9** constituting the brake elements are each provided with a plurality of openings **12** of round configuration.

While I believe the above described embodiments of my invention to be preferred embodiments, I wish it to be understood that I do not desire to be limited to the exact details of design and construction shown and described, for obvious modifications will occur to a person skilled in the art.

CLAUDE DORNIER.

PUBLISHED

MAY 25, 1943.

BY A. P. C.

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BRAKE FOR AIRCRAFT

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Fig. 1.

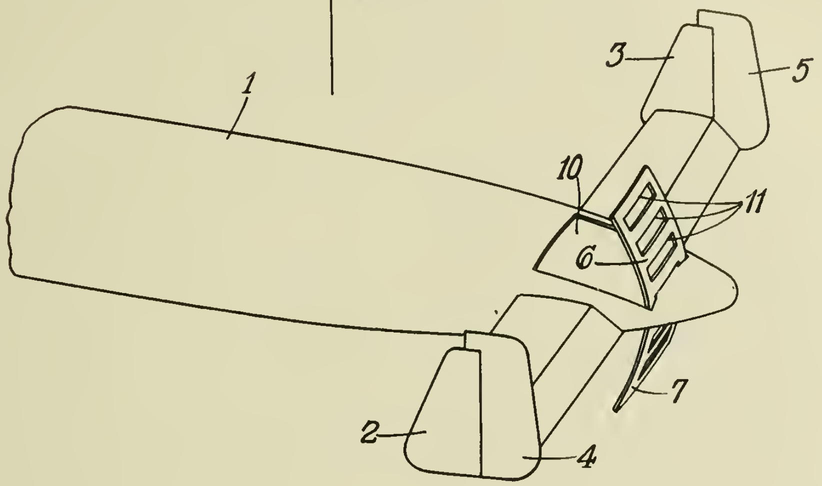
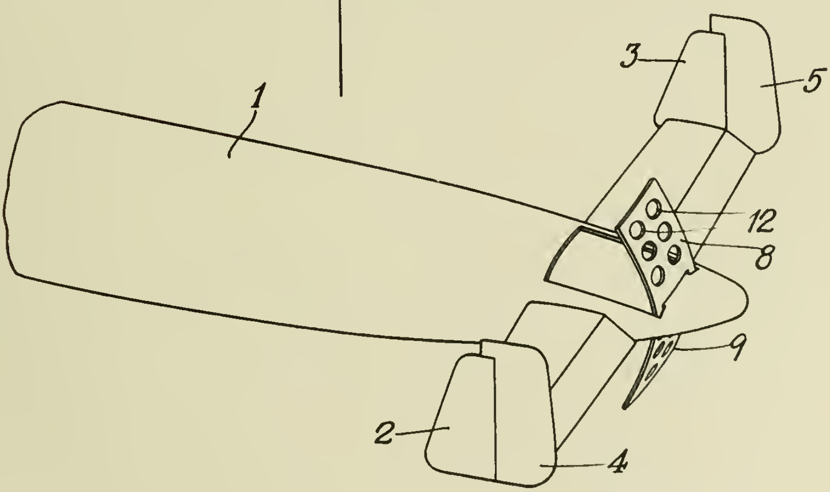


Fig. 2.



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ALIEN PROPERTY CUSTODIAN

GERM-PROOF CLOSURES FOR CONTAINERS

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Application filed January 31, 1939

This invention relates to a germ-proof closure for containers, such as bottles, cans, barrels or the like. Closures which allow the entrance of germ-free air, but make the outflow of the contents impossible when the container is in an inclined position, for instance during transport, have hitherto not been available in a useful form.

The invention therefore proposes a closure which consists of an insertable body for containing the germ filter and of a lip-like non-return valve of a known kind, which is drawn over the end of the insertable body. This insertable body may be made of glass or other material and be filled with any germ filter, for instance salicylic cotton wool. The lip-like valve placed on the lower end of the insertable body allows the entrance into the container of air rendered germ-free in the germ filter, but makes the outflow of contents impossible, whatever the position of the container.

When there is a discharge opening at any place of the container, for instance at the bottom, the insertable body for the air inlet opening, which contains the germ filter, may be provided with a flanged rim, below which a sealing ring of elastic material is arranged. This form of seal is extremely simple and occupies no space outside the container. It supports the filter by means of the container itself, cannot be damaged during transport and is easily cleaned.

When there is only a single opening in the upper part of the container, the tubular insertable body provided with the germ filter and the lip-like valve may be taken alongside a closable outlet tube through a stopper. On the container being placed at an inclination after the outlet tube which extends to the bottom of the container has been opened, the contents can flow out, when the air can flow in through the filter of the tubular insertable body, that is free from germs. The insertable body which serves as the air inlet opening may of course be connected to a compressed air or compressed gas pipe, so that the liquid will be forced out of the container in a known manner. In this constructional form as well the lip-like valve will prevent the liquid entering the filter.

In Figs. 1 and 2 of the accompanying drawing two different constructional forms of the new germ-proof closure are shown in section.

The insertable body 2 of the closure, which is fitted with the germ filter 1 and may be closed by a stopper or the like, has an extension 3 of smaller diameter and at the top a flanged rim 4 by means of which the insertable body provided with the slipped on sealing ring 5 may be pushed into the bottle neck 6 serving at the air inlet opening or be caused to rest on it. Over the extension 3 the lip-like valve consisting of the rubber tube 7 with the lip 8 is slipped, which valve opens only inwards, that is to say allows germ-free air to enter the bottle, but prevents the outflow of the bottle contents through the filter. The bottle is emptied in a known manner through an emptying arrangement provided at any part of the bottle.

When there is no special discharge opening, then, as shown in Fig. 2, there is taken through a stopper 9 which is either screwed into or pressed for instance into the neck 11 of a bottle 12 both an outflow tube 13 for the liquid and the cylindrically formed insertable body 14 with the germ filter 15 and the lip-like valve 16. The upper end of the insertable body 14 may be connected by tubing 17, with or without a further interposed germ filter, to a compressed air producer, a compressed gas bottle, for instance a carbon dioxide bottle, or the like. The outflow tube 13 extends directly or with an attached piece of tubing 18 or the like to the bottom of the bottle 12. The other end of the outflow tube 13 may be provided with an attached piece of tubing 19 which leads to the place of delivery and may be closed by any closing member. On the latter being opened, the compressed air or the like entering the bottle through the insertable body 14 in a germ-free state will force the liquid out through the tubing 18, the outflow tube 13 and the attached tubing 19.

During transport or, when the container is not in use for some time, the outflow tube 13 and the insertable body 14 will preferably be tightly closed at the top with any sealing device, for instance with stoppers, rubber caps, cocks or the like.

These germ-free closures are particularly suitable for transportable containers containing liquids which are sensitive to bacteria, such as fruit juices, milk and the like.

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PUBLISHED
MAY 25, 1943.
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GERM-PROOF CLOSURES FOR CONTAINERS

Filed Jan. 31, 1939

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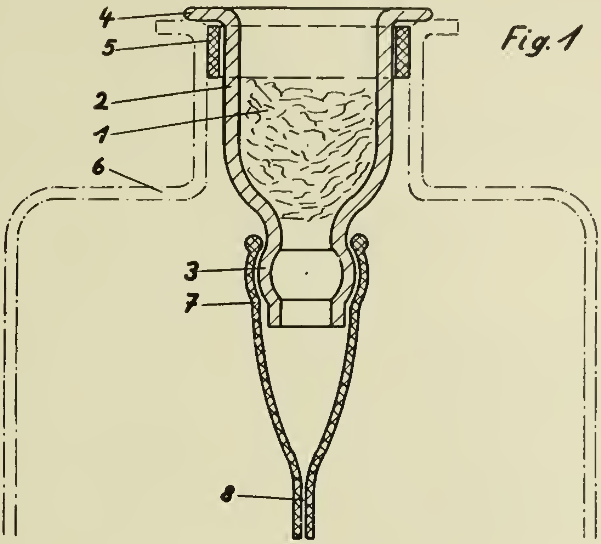

Fig. 1

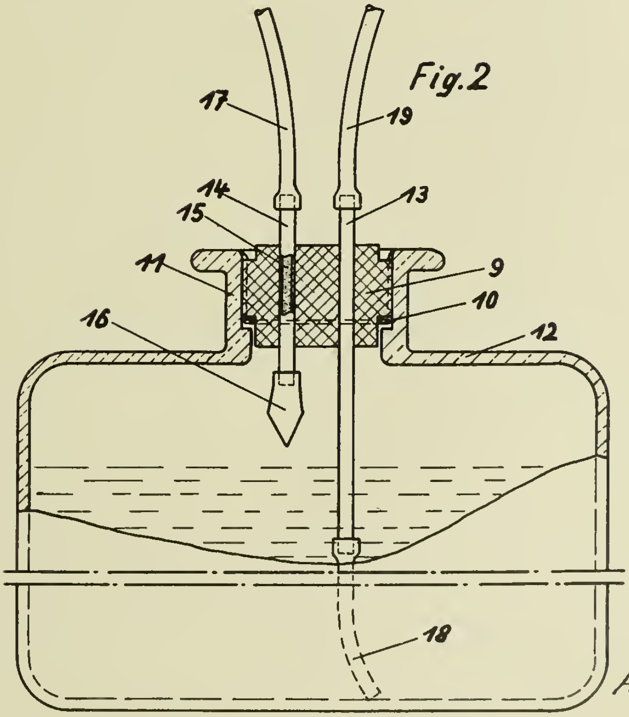

Fig. 2

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Published May 25, 1943

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ALIEN PROPERTY CUSTODIAN

BRAUN TUBES

Maximilian Messner, Berlin, Germany; vested in the Alien Property Custodian

Application filed February 4, 1939

This invention relates to improvements in or concerning cathode ray or Braun tubes, and more particularly to the high vacuum type of such tubes for use in television systems.

It has been experienced in the past that the fluorescent screen of high vacuum Braun tubes becomes damaged under certain operating conditions. Investigations in this respect have proven that the fluorescent screen suffers during the course of longer active use, even in cases that the tube is of the hard vacuum type, and that the damage occurs on the fluorescent screen in the shape of a dark line or spot, whether the cathode ray is electromagnetically deflected along one or both coordinates of the coordinate system. It must be noted in this connection that the damages heretofore referred to are not identical with the well known injuries of the fluorescent screen due to the screen etching phenomenon. Further research work carried out in this field teaches that damages of the first mentioned kind result from the action of certain ions, the barium ions, for example, which practically remain uninfluenced by the cathode ray deflecting means, provided that the Braun tube operates with electromagnetic deflection. It has been found that the above mentioned ions which have frequently been observed and also taken in account in connection with glow cathode tubes become influenced in Braun tubes solely in cases that electrostatic deflection of the cathode ray is employed, but remain almost immune to an electromagnetic deflection due to their very great mass as compared with that of the electrons. An electrostatic field imparts the same deflection to all particles of equal charge independent of their mass, since particles of greater mass move with a correspondingly reduced velocity, provided that they have previously been accelerated by the same potential, while on subjecting these particles to an electromagnetic deflection under exactly the same operating conditions as heretofore mentioned, the relationship between the effective deflections is: VE/m, where VE denotes the charge, and m the mass. This rule clearly shows that certain precautions must be taken in connection with electromagnetic cathode ray deflection in order to eliminate the above mentioned difficulties.

This is accomplished according to the main feature of my present invention by directing the cathode ray in its state of rest toward the outer edge or idle area of the fluorescent screen, instead of leaving the cathode ray incident upon the active image area of said screen also during the absence of incoming image and synchronization impulses. This transposition of the cathode ray onto the idle area or surface of the screen is effected by means of an electrostatic direct current field which removes deleterious ions from the active image area.

The invention will be more readily understood from the following description taken in conjunction with the accompanying drawing, the single figure of which schematically shows a Braun tube of standard type to which the invention is applied.

The useful deflection of the cathode ray beam away from its new position of rest imparted thereto on account of an artificial displacement by virtue of an initial or biasing electrostatic deflection applied at the point A of the Braun tube schematically shown in the drawing is magnetically effected in the opposite direction with respect to said initial or biasing electrostatic deflection. This facility makes sure that the ions remain in their positions, that is, outside the actual area of the image, so that the harmful ions are withdrawn from the image reproducing surface of the fluorescent scren. The corresponding deflection along the other coordinate at right angles to that heretofore considered may be carried out either by means of electrostatic or electromagnetic fields. The actual or useful deflection of the cathode beam takes place at the point B of the drawing along the coordinate of the electrostatic initial or biasing deflection, for instance, by the agency of coils or windings through which a pulsating direct current but no alternating current flows. This may be realized according to a further feature of my invention by directly connecting the deflecting coils or windings in the anode circuit of a final tube following a time base generator. The direct current portion thus applied to the deflecting coils magnetically restores the initial or biasing electrostatic deflection to the range of active operation. Because of the fact that the characteristic of the above mentioned final tube hardly becomes utilized exactly to the current value nil, the residual current thus present involves an appreciable minimum deflection in the vicinity of the artificial position of rest of the cathode ray which position might be critical due to the presence of the harmful ions, so that all possibilities for these ions to detrimentally affect the virtual area of the fluorescent screen are reliably eliminated.

It is also possible in accordance with still a further feature of the invention to provide particular direct current fed coils or windings which have for their object to convey back to the central

surface of the fluorescent screen the electrons only of the combined mixture of electrons and ions initially removed therefrom on account of the biasing electrostatic deflection.

The pure electron beam thus incident upon the central or active area of a Braun tube fluorescent screen may be utilized for a varity of purposes, e. g. for being so deflected as to produce an image in accordance with any optional method or scheme without running the risk that the deleterious ionic effect might injure the screen. Of course, precautions must be taken that the range through which the electronic beam passes during the useful deflection does not become enlarged into the range of the cathode ray artificially produced therefor by virtue of the electrostatic initial or biasing deflection.

It is an essential advantage of the arrangement according to my above described invention that the well known standard type of cathode ray or Braun tubes requires no principal alterations for its application. The only additional means which are necessary for carrying out my invention is a simple electrode structure such as a pair of deflecting plates for generating the necessary electrostatic direct current field.

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BY A. P. C.

M. MESSNER

BRAUN TUBES

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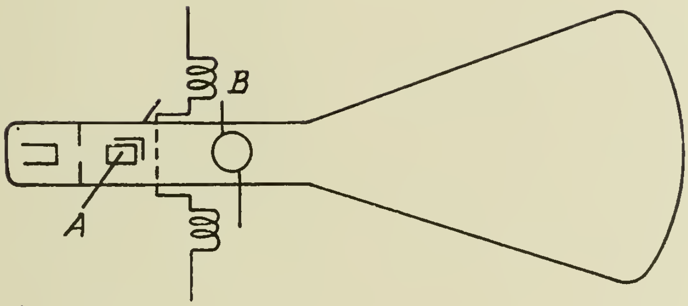

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ALIEN PROPERTY CUSTODIAN

HELICOPTER HAVING TWIN INTERMESHING ROTORS

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Application filed February 6, 1939

The present invention relates to helicopters and in particular to helicopters having twin intermeshing rotors and wherein the extensions of the rotor shafts diverge upwardly and the distance between the hubs of the rotors is smaller than the radii of the rotors. For the sake of brevity an aircraft of this kind is hereinafter referred to as a double or twin helicopter; in such helicopters the rotors are generally driven, but in case of engine failure they may be arranged to autorotate.

In known helicopters having a rotor arrangement different from that mentioned above it is usual to join the rotor blades to the hub rotor shaft in such a manner that the blades are free to oscillate or flap with a motion perpendicular to their plane of rotation, and that the bending movements transmitted by the blades to the rotor shaft remain relatively small. On the other hand in rotor arrangements of the twin rotor kind particularly referred to in the first paragraph hereof, the risk has not so far been taken of allowing the rotor blades to flap freely in flight; on the contrary, in the arrangements of the aforesaid kind the possibility of movement on the part of the blades in flight in a direction perpendicular to the plane of rotation was limited by means of stops or even by fixing the blades rigidly in order to preclude the danger of the blades of one rotor coming into contact with the blades of the other rotor rotating in the opposite direction with respect to and intermeshing with the former. However, these mechanical measures for preventing mutual contact between the blades entail the drawback that, in flight, owing to the aerodynamic forces acting upon the blades, considerable and dangerous bending moments are transmitted by the blades to the rotor shafts and thus also to the fuselage, and this made the utilization of twin rotors of this kind practically impossible. The inner and central blade portions of two blades rotating in opposite directions intersect in the case of a twin rotor according to the invention, at a short distance only from each other, and, particularly in the case of the tapered blades preferably used which have a greater chord towards the root, they exert a great aerodynamic action upon each other. For the purpose of preventing blade oscillations it is therefore absolutely necessary, particularly in the twin rotor system, to ensure that the variation in thrust of a blade is as small as possible during its rotation. In the case of fixed blades or when flapping blades have insufficient freedom of movement, great variations in thrust occur during forward flight; in that case it is practically impossible to avoid two blades intersecting each other precisely at the point of maximum thrust. The tendency of the blades to forced vibrations would in that case be intolerably great.

A method of joining the blades to twin rotors which provides thorough equalization of thrust during forward flight has also already been described, the blades of which are however merely rotatable about longitudinal shafts rigidly connected to the hub; Contrary to the case of freely flapping blades, there occurs in this case at the root of the blade a thrust moment which is variable during the rotation. The hubs of the rotor and the aircraft are thus, despite the uniformity of the total thrust not free from bending moments inasmuch as during rotation, the centre of thrust moves longitudinally along the blade. The invention is based on the realization that in the case of twin rotor aircraft it is particularly important to avoid bending moments acting upon the hubs and the rotor shafts, namely for the purpose of keeping the dimensions of these component parts as small as possible and thus to facilitate the most satisfactory intermeshing of the rotors. For this reason it has been found to be far more satisfactory in the case of twin rotor aircraft to accept a certain amount of inequality of thrust and to tend instead to obtain a vanishing or almost vanishing thrust moment such as can be achieved by the arrangement of freely flapping blades.

According to the invention the drawbacks of the known twin rotor aircraft of the kind mentioned in the first paragraph hereof are overcome in that the amplitude of oscillation of a blade oscillating in a known manner with a component of motion perpendicular to the plane of rotation is limited in flight merely by means of aerodynamic forces. Contrary to expectations it was found on the basis of tests that this is sufficient to ensure the production of a practicable helicopter having also substantial advantages when compared with helicopters hitherto known. The new twin rotor machine possesses the advantage over the known helicopters having co-axially superimposed rotors that one rotor is not located in the downstream of the other rotor; on the contrary the so-called twin-rotors behave as a single rotor having two directions of rotation and which, contrary to other known helicopters having only one rotor, do not require additional means for counter-balancing the torque generated by the driven rotor.

Compared with the known and hitherto successful helicopters having two rotors disposed side by side and rotating in opposite directions and having a distance between their shafts amounting to more than twice the length of a blade, the new twin rotor helicopter possesses the advantage that it avoids the use of large outriggers which are very heavy and offer great air resistance and which are necessary in the aforesaid known helicopters owing to the great distance between the rotor shafts, and that moreover the aerodynamic efficiency of the two rotors is improved by the intermeshing and overlapping of the blades.

The various constructional forms of the invention comprise special inventive means partly new and partly known per se, which facilitate or promote the carrying out of the inventive idea, in particular means which minimize the flapping movement of the blades in flight without the use of stops or the like and, in case of emergency, for example in the case of wind gusts keep the flapping range of the blades of one rotor away from the flapping range of the other rotor. These various special basic means are described hereinafter with reference to the drawings, which however are intended merely to illustrate various forms of construction of the invention and of the said means by way of example.

Figure 1 illustrates the various positions of the blades in a known helicopter having only one rotor and direct control and freely flapping blades, the pitch and flapping angle of which are independent of each other, the illustration being a side view. The position numbered **1** is that taken up during slow forward flight: position **2** occurs when a wind gust strikes the blades from above: the blades then enclose an angle of more than 180°. The position numbered **3** is brought about during rapid forward flight, when the rear blade is deflected downwardly and the front blade is deflected upwardly. In the case of a helicopter of this kind there is a free flapping of the blades to below the horizontal position when no stops are provided for limiting the amplitude of the flapping motion or when such stops are not operative; thus it is advisable to avoid such stops in flight in order to prevent a transmission of dangerous bending moments and vibrations to the fuselage.

Figure 2 illustrates a side view of the positions of the blades under different conditions in a known helicopter having only one rotor similar to the rotor in Figure 1, wherein provision is however made for controlling not the entire head nor the entire hub of the rotor, but only the angle of incidence of the individual blades. The positions marked **1** and **3** correspond to the similarly numbered positions in Figure 1. The position **4** of the blades occurs in that controlling movement which is usually designed as "pulling up the nose of the helicopter". During this controlling movement the tips of the blades describe during their rotation and with a periodical alteration of their pitch, a circle in a plane (tip circle) which is displaced with respect to the fuselage in the same direction and to the same extent as when a corresponding controlling movement or displacement of the hub of the rotor in Figure 1 is carried out.

According to whether this backward inclination of the plane of the tip circle during rapid flight (position **3**) is greater or smaller than the backward inclination effected by means of an intentional control movement (position **4**), there will be need for greater or smaller free flapping angles in flight either in the case of the direct control according to Figure 1 or of the blade control according to Figure 2. Calculations and tests have shown that the blade control according to Figure 2 generally requires the smaller flapping angle.

Figure 3 illustrates a side view of an arrangement of the two rotors in a constructional form of double helicopter according to the invention, that is to say for rotors each having three blades, as seen in the direction of flight.

Figure 4 illustrates a plan view from above of the arrangement in Figure 3.

The direction of rotation of the rotors is preferably such that at the point of intersection of two blades the upper blade is moving in the direction of flight. The object of this arrangement is to prevent the air flow which is interrupted in the vicinity of the retreating blade from coming within reach of the succeeding blade advancing through the descending air flow.

Figure 5 illustrates a plan view of a corresponding arrangement of two rotors in a constructional form of double helicopter according to the invention, in this case for rotors each having only two blades.

Figure 6 illustrates in side elevation a constructional form of double helicopter according to the invention. The aerodynamic lifting force L exerted by the rotors on the fuselage of the aircraft possesses with respect to the centre of gravity S a lever arm *b*. Said lever arm *b* is so proportioned that the moment of the aerodynamic force L with respect to the common centre of gravity S of the aircraft is generally as great as the residual torque acting in the opposite direction of rotation with respect to the point S, said residual torque being due to the rotation of the rotor shafts in opposite directions and to their relative angular arrangement, the magnitude of said residual torque depending upon the torque of the two rotors.

As this torque reaction is not counter-balanced by the rotation in opposite directions of the rotors it may possess a variable order of magnitude, and provision is according to the invention conveniently made for a compensating controlling movement to be manually or automatically super-imposed upon the standard forward or blade control (Figure 1 or 2) or other usual aircraft controls, said compensating movement counter-balancing the torque reaction, which has not already been taken care of by suitably proportioning lever arm *b*.

Consequently, for the purpose of effecting this balancing out of the residual torque reaction there must be provided in such control members as may be fitted, guided control movements amplitudes which are larger than the corresponding guided control movements or amplitudes respective which would be necessary for a corresponding rotor-driven aircraft having two parallel rotor shafts.

Figure 7 illustrates a constructional form of a twin helicopter according to the invention corresponding to Figure 6 but seen from the front. This figure illustrates a few generally recommended features for twin helicopters according to the invention in particular the feature that the extensions of the rotor shafts which are shown in dotted lines (at A) intersect in the vicinity of the common centre of gravity S, and preferably above said centre of gravity. This arrangement is to be preferred in consideration

of the thrust forces, which may be of unequal magnitude upon the two rotors for example owing to the lateral movement (sideslip of the aircraft) or in consequence of different pitch of the blades of one rotor with respect to the blades of the other rotor, the residual thrust reaction to said unequal thrust forces with respect to the centre of gravity S will however be small when the point of intersection A of the line of force lies in the vicinity of the point S. When this point of intersection A lies above the point S during the side slipping of the aircraft a stabilizing moment will be produced similar to the moment resulting from the known dihedral angle of the supporting surfaces of fixed wing aircraft.

Moreover, it is advisable, even if not absolutely necessary according to the invention, that in accordance with Figure 7 the line connecting the two hubs shall extend in manner known per se perpendicular to the direction of flight; for this arrangement offers the advantage that the aerodynamic conditions do not differ for the two rotors during forward flight and that is avoids the one rotor working in the downstream of the other rotor thus increasing the aerodynamic efficiency,—and this is important for avoiding mutual interference where the rotor blades intermesh.

Figure 8 illustrates a constructional form of the rotor of a double helicopter according to the invention as seen vertically from above. This form of construction is in turn recommended for intermeshing rotors, because the blades 7 are joined, not immediately adjacent the rotor shaft nor direct to the hub 5, but by means of the flapping joints 8 to the arms 6 which are rigidly mounted on the hub and extend radially; due to this constructional measure it is a simple matter to keep the flapping range of the blades of one rotor removed from the flapping range of the blades of the other rotor, as will be seen from the following with reference to Figure 9.

According to the constructional form illustrated in Figure 8 and subsequently illustrated constructions, preference is given to relatively rigid rotor blades, these being at least as rigid as the hitherto usual blades, which when the trapezoidal shape is chosen may be made still larger; this in turn is done for the purpose of avoiding contact between the blades of one rotor and the blades of the other rotor also when extraordinary flying conditions occur suddenly, such as for example gusts of wind, which might cause the blades to bend.

Figure 9 illustrates diagrammatically the arrangement of two intermeshing rotors according to the invention. In this figure a indicates the distance of the flapping hinge of one blade 7 from the axis of rotation 10, 2γ is the angle enclosed by the extensions of the two axes of rotation, β is the flapping angle of a blade 7, said angle being positive when the blade is located above the imaginary plane passing through the hub perpendicularly to the axis 10, the arms 6 also extending in the said plane.

According to Figure 10 an examination and graphic representation has been made of the free flapping angles of the blade which are possible in a rotor arrangement according to Figure 9 for various distances a between the flapping hinge and its axis of rotation. On the horizontal drum line of the diagram in Figure 10 there is marked off the distance x between the point of intersection of the plane projection of the centre lines or longitudinal axes of two blades 7 in Figure 9 which during flight happen to be exactly superimposed and the appertaining axis of rotation 10. As a unit of length the distance between the hubs of the two rotors was taken to be $c=1$. On the vertical co-ordinate axis there are marked off the vertical distances y between the centre lines or longitudinal axes of the said blades 7 which just happen to be above each other, or between their radial hub arms 6 in the point of intersection of their plane projection. The three curves drawn apply to the following three values of the hinge distances a viz. 0.5, 0.7 and 0.9. These values at the same time indicate the ratio of a to c applicable to each individual curve.

The distances y have been calculated for a flapping angle of $\beta=-8°$, the blades stopping downward towards the plane of rotation. Moreover, as in the case of Figure 9, it has been accepted in Figure 10 that the angle of intersection enclosed by the two rotor shafts amounts to 24°, viz. $2\gamma=2\times12°$.

In these circumstances it is found that the vertical distance y between two immediately superimposed blades and thus also the clearance available for additional flapping movements of said blades is greater the greater the distance a of the flapping hinge from the rotor shaft. Such clearance for additional flapping movements is generally required, because, as tests and calculations have shown, coning angles up to $-10°$ downwardly occur at high speeds in the rear sector of the disc of rotation during the forward movement of the blade. Moreover, provision must be made for an additional downward flapping movement of the blade of about 6° when wind gusts from above influence the blades unless a limiting of this angle has been obtained by aerodynamic forces by means hereinafter indicated.

In connection with Figures 9 and 10 calculations and experiments have shown that it is advisable to choose the distance d between the flapping hinge 8 of the blade 7 of a rotor and the appertaining rotor shaft, so that it is about 0.8 to 1.2 times the distance c between the two hub centres, and further, if desired, to deviate from the arrangement of the hub arms 6 shown in Figure 9 by arranging said arms upon the surface of an upwardly open cone having the rotor shaft 10 as its own axis of rotation as illustrated in Figure 11. Owing to the above mentioned measures it is possible to keep the distance c between the centres of the hubs smaller than 10% of the diameter of a rotor, and the angle 2γ enclosed by the axes of rotation smaller than 30°, which is also recommended for constructional reasons for the purpose of carrying the invention into effect. By minimizing the angle γ, the loss in efficiency is also minimized, said loss arising from the fact that only the vertical components of the thrust of each individual rotor can be made to serve the purpose of sustaining the aircraft. Moreover, by keeping the distance c between the rotor hubs small, the air resistance is also kept low and the desirable displacement of the point of intersection of the axes of rotation above or in the vicinity of the centre of gravity of the aircraft is also thereby effected.

In Figure 11 the curves in Figure 10 have been used for the purpose of drawing the path of a blade of one rotor, above the hub 5 and the inclined hub arm 6 with the flapping hinge 8 and the shaft 10 of the other rotor. It will be

seen from this figure that it is advisable to arrange the arms **6** of the hub upon the surface of an upwardly open cone above the rotor shaft also in order to adapt as far as possible the path of the said arms to the path of the blades passing above them.

Figure 12 illustrates a constructional form of rotor corresponding to Figure 11 having inclined hub arms **6**, drawn to a smaller scale and seen in side elevation. The arms **6** are mounted in a hub **5** which is rigidly connected to the rotor shaft **10**.

Figure 13 illustrates a constructional form similar to the form illustrated in Figure 12, wherein however the hub arms **6** are carried by a centre member **11** which is hinged at **9** to the rotor shaft **10**. Also in this case the hub arms carry the flapping hinge **8** of the blades, also drag hinges **12** which establish connection between the flapping hinge **8** and the hub arms **6**. A construction similar to the form illustrated in Figure 13 and having a corresponding centre member **90** is illustrated in plan view in Figure 20.

It is true that drag hinges **12** are known in helicopters having only one rotor or two nonmeshing rotors, but in the case of intermeshing rotors such drag hinges have hitherto been avoided, as it was assumed that the drag movement would involve the risk of the blades of one rotor coming into contact with the blades of the other rotor. Calculations which were confirmed by tests showed however that the horizontal amplitudes of oscillation of the blades in flight amount to only a few degrees, so that for the purpose of eliminating the transmission of bending moments or of reducing said bending moments it is advisable to utilize drag hinges which are known per se, also in the construction of twin helicopters.

According to further tests it was found that the rotor worked particularly smoothly when, in accordance with Figure 13 but contrary to the hitherto usual arrangement, the drag hinges are attached directly to the hub or to the arms **6** of the hub, that is to say on a part which does not oscillate during the rotation of the rotor, and between the flapping hinges **8** and the rotor shafts **10**. The reason for the smooth working thus obtained lies in that due to this arrangement of drag hinges the angle enclosed between the flapping hinge **8** and the blade axis does not vary.

Figure 13 further illustrates the arrangement of friction dampers **120** below the drag hinges **12**. This arrangement is recommended, as against the more usual arrangement above the drag hinges for double helicopters in general, as the only free space available in which the dampers can be placed is usually below the drag hinges without interfering with the clearance for the flapping movement of the blades or the clearance between the blades and the hub.

The construction according to Figure 13 affords a fundamental advantage compared with the construction illustrated in Figure 12 owing to the hinged attachment of the centre member **11** to the rotor shaft **10**, according to Flettner's German Patents No. 617,916 and 652,018 and 653,402. The use of this hinged arrangement as hereinafter described in further forms of construction illustrated in Figures 15, 19 and 20, is important precisely in a double helicopter, wherein for the above stated reasons, hub arms rigidly connected to the centre member are recommended inasmuch as these hub arms **6** form with respect to the rotor shaft **10**, lever arms for flapping moments, which would be transmitted to a considerable extent to the rotor shaft **10** and thus also to the fuselage, owing to the forces which would be exerted by the blades **7** upon the hinge joints **8** and **12**, if the centre member **11** had not been arranged to hinge with respect to said flapping moments.

In a rotor having three or more blades, universal joints preferably take the place of the joint **9** which is intended for rotors having only two blades. Instead of arranging such individual joints between each rotor shaft of the appertaining rotor, it will be sufficient for the purpose of avoiding transmission of flapping moments to the fuselage, to provide only one universal joint between the fuselage and a housing encasing in manner known per se the two individual rotor shafts **10** of the two rotors, and being adapted to be pivoted together with said rotor shafts.

Figure 14 illustrates a plan view of a form of construction of double helicopter according to the invention, wherein control screws **33** are provided. The pitch of the blades of said control screws may be adjustable in known manner (not illustrated) in order that the direction of thrust of the control screw may be altered at will according to the degree of control of the fuselage which is desired. The fact is that the use of such means of control, which are known per se, is recommended in particular for controlling the position of the fuselage in flight of a double helicopter having freely flapping blades and especially in connection with a forward control known per se according to Figure 1, or blade control according to Figure 2 (and Figure 20) in order that the additional flapping movements or inclinations of the blades of the rotors caused by such controlling may be kept small, in order to prevent all risk of contact between the blades of one rotor with the blades of the other rotor. To do this the controlling function of the rotors can be partly or wholly taken over by other usual means of control. In the latter case there is no need to use forward or blade control at all. Where these latter controls are preferred owing to other advantages, for example for hovering purposes, it is recommended that the direct control or the blade control be coupled with any other means of control; such coupling may be adapted to be engaged or disengaged at will. Control by means of the control screw possesses the advantage of remaining operative also when hovering.

However, instead or besides control screws, other usual control means such as rudders, elevators or ailerons may be used without or in addition to direct rotor control or blade pitch control. There may also be provided at the front or at the rear end of the fuselage one single control screw, for example one having a substantially vertical shaft; when the pitch of the blades of said control screw is simultaneously varied in the same direction, the effect is that of an elevator control; when the pitch of the blades is periodically varied during rotation in manner known per se, the effect is that of a lateral control. Finally elevator and lateral control can be effected by means of a pair of control screws having substantially vertical axes by simultaneously varying the pitch of all the blades of both or of only one of the control screws, when one of said control screws is arranged on one side and the other control screw on the other

side of the fuselage at the front or rear end thereof.

When separate control screws are utilized in a double helicopter, these may serve the purpose of compensating for the residual torque reaction resulting from the relative angular arrangement of the rotor shaft 10, by a simultaneous alteration of the pitch of their blades.

Figure 15 illustrates the mounting of a pair of blades in a construction of double helicopter according to the invention. In this case the rotor shaft 10 encloses an angle τ with the longitudinal axis of the blade 7; the spar 66 connecting the two blades is mounted rotatably about its main axis at 800 in such manner that the pitch of a blade is reduced during the upward movement and increased during the downward movement of the blade. This effect is in general desired in the case of double helicopters having freely flapping blades in order to keep the range of the flapping movements which, in parenthesis are caused by the aerodynamic forces, as small as possible. The same remarks apply to the constructions according to Figures 18, 19 and 20 hereinafter described which are similar in this respect.

Figure 16 illustrates a constructional form of the invention in front elevation. In this case there is provided a housing 13 encasing the two rotor shafts 10, the latter being mounted in the said housing. The housing is pivotable about a transverse axis or shaft 14 extending transversely of the direction of flight. The said transverse shaft is rotatably mounted in a bearing member 15 connected to the fuselage.

Figure 17 illustrates the construction according to Figure 16 in a side elevation. It will be seen that the transverse shaft 14 carries a control lever 160 which is freely rotatable upon said shaft, the lever being connected, by means of parallel link mechanism 17, 18, 19 to the head or hub 5 (compare Figures 1 and 2) so that when the freely rotatable housing is pivoted the angle of the swash plate 13 and thus at the same time the angle enclosed by the planes of the circles described by the tips of the blades 7 are not altered with respect to the fuselage. For this purpose the second rotor (compare Figure 16) possesses precisely the same control as illustrated in Figure 17, the control being omitted here merely for the sake of clearness. This mounting of the housing (13) encasing both rotor shafts has the advantage that an automatic compensating of the residual torque reaction resulting from the relative angular arrangement of the rotor shafts is effected about the transverse shaft 14.

As mentioned in a general way in the case of Figure 13 there may also be provided in the case of the particular constructions illustrated in Figures 16 and 17 a universal joint-like mounting of the housing (13) about a further axis of rotation (extending perpendicular to the transverse shaft 14, that is to say extending in the direction of flight) in order to keep lateral moments away from the fuselage.

Figure 18 illustrates a form of construction of the hingeing and control of the blades of a rotor according to the main claim of Breguet's German Patent No. 567,584, class 62b which may with advantage be used in a double helicopter according to the invention in order to keep the flapping movement as small as desired.

Figure 18 is a plan view of the said construction, partly in section. To the rotor shaft 10 there are hingedly attached at 90 the hub arms 600 in such a manner that together with the blades they are able to carry out flapping movements independently of each other about the axis 90. Within the arms 600 there are located the control hinges 35. At the outer end of said hinged shafts 35 there are mounted universal joints consisting each of a drag pin 12 and a flapping pin 8, to which the blade spars 70 are attached. For the purpose of rotating the control shafts 35 control levers 134 act obliquely upon their outer ends, said control levers 134 being controlled by means of a push rod, which in the drawing is seen in a longitudinal direction, and a lever 142. The lever 142 is firmly attached to a swashplate 141 which in a manner not illustrated in the drawing is universally mounted with respect to the rotor shaft 10, and rotates when the rotor shaft rotates. Upon this swashplate there is rotatably mounted a guide ring 48 by means of a bearing 47, the control handle 16 acting upon the said guide ring 48 for the purpose of tilting it in all directions.

With the arrangement shown in Figure 18, when a blade flaps upwardly about the hinge 90, the pitch or angle of incidence of the blade is reduced, as the hinge 8/12 is moved upwardly with the upwardly moving blade, whilst the head 143 of the hinge is retained by the appertaining push rod 142 in its initially determined fixed position, so that the control lever 134, is pivoted in the direction in which it reduces the pitch of the blade. Conversely a pivoting of the control lever 134 in the opposite direction causes the pitch of the blades to be increased during the downward flapping of the blades. Further explanations of details of construction regarding this control may be gathered from the specification of German Patent No. 567,584 and for the sake of simplicity they are omitted here.

In the arrangement illustrated in Figure 18 the aerodynamic forces acting upon the blades are utilized for the purpose of causing the desired independent automatic variation of the pitch of the blades during flight. This offers the advantage that also localized gusts, for example, acting upon one blade only, involve an automatic compensation by varying the pitch of this particular blade.

However, the arrangements for keeping the beating movements small are simpler from the point of view of construction, when in manner known per se the compensating control of one blade is made dependent upon a corresponding control of the pitch of the other blades or of the other blade by means of a pivotable centre member common to all the blades. Constructional forms of such arrangements the application of which to double helicopters according to the invention is to be preferred are illustrated in Figures 15, 19 and 20. Fundamentally the advantage which these arrangements have over Breguet's arrangement in Figure 18 is that all the blades cooperate in effecting a compensating of the pitch due to the aerodynamic forces acting upon said blades.

In other respects the constructions shown in Figures 15 and 19 are based upon the same fundamental idea as regards the arrangement and adjustment of the flapping hinges, as in Breguet's arrangement in Figure 18. This basic idea consists in providing a flapping hinge axis located at an angle with respect to the longitudinal axis of the blade due to which the pitch of the blade is reduced during the upward flapping of the blade and increased during the downward

flapping of the blade. In the arrangement according to Figure 18 such a flapping hinge is not materially embodied yet virtually present, as the blades do in fact carry out a flapping movement about imaginary flapping shafts extending at an angle with respect to the longitudinal axes of the blades, due to the control described, by means of the firmly retained end 143 of the control levers 134. In Figures 15 and 19 on the other hand the flapping hinge for both blades and disposed at an angle is materially embodied in the form of the shaft 800.

Figure 19 illustrates a plan view of an inclined arrangement of the blades recommended also for twin helicopters and corresponding substantially to the arrangement in Figure 15, there being however provided for the blades in the former in addition to the inclined common flapping hinge 800, separate flapping hinges 8 upon stub axles 50 extending at an angle with respect to the shaft 800, in order to reduce the bending moments in the blade spars 70. The bearing of the shaft 800 forms part of the rotor shaft 10 and thus rotates when the latter rotates.

Figure 20 illustrates the already previously proposed method of reducing the pitch of the blade according to Flettner's German Patents 617,916, 652,018 and 653,402 when the blade flaps upwardly, and of increasing the said pitch when the blade is flapping downwardly. The use of such devices in double helicopters according to the invention is recommended as against the previously described method according to Figure 19, especially when the periodic individual control of the pitch of the blades, which is preferred for other reasons explained hereinafter, is to take place.

Figure 20 illustrates a plan view partly in section of such a control in a rotor having only two blades. However, it is an advantage in this kind of control that from constructional point of view it can easily be adapted to rotors having more than two blades in contradistinction to the controls according to Figures 18 and 19. In the last mentioned case of more than two blades, the hub carrying all the blades must be pivotable in all directions with respect to the rotor shaft, according to German Patents No. 652,018 and No. 653,402.

In the case of Figure 20 the rotor hub 110 which is common to the blades is pivotable about the shaft 900 merely in the manner of the beam of a balance, said shaft 900 being mounted in a part connected to the rotor shaft 10 and thus rotates when the latter rotates. The blades are mounted in the habby means of control shafts 35 which are hinged in the direction of the longitudinal axis of the blades and rotatable about the said shafts 35. The adjustment of the pitch of the blades about these shafts 35 is effected fundamentally in the same manner as in Figure 18 (according to German Patent No. 653,402) by means of the control arms 340, which are rigidly mounted on the shafts 35 and otherwise correspond to the control levers 134 in Figure 18. At a certain setting of this blade control the end points of the control arms 340 are fixed in respect to the rotor shaft, so that when the aerodynamic forces cause the hub 110 to be pivoted about the axis 900, the desired variation of the pitch is effected owing to the control shafts 35 being turned and the control arms 340 pivoted.

The control of the flying position of a helicopter or double helicopter, by means of periodic variation of the pitch of the individual blades during rotation, explained with reference to Figures 18 and 20 in the case of a rotor having two blades (or two intermeshing rotors each having two blades) (compare Figure 2) is recommended for a double helicopter according to the invention, also when using rotors having more than two blades because in the case of said control calculations and tests have shown that the necessary free flapping range of the blades is smaller than in the case of the usual direct control. The periodical adjustment of the pitch angles produced by the blade control is, in the case of a hub according to Figure 20 or a hub which is pivotable in all directions (Figures 16 and 17) so influenced, as may be seen in Figure 20, that a maximum value of the pitch angle is obtained in the position of a blade perpendicular to the drag hinge and on the side where the blade is moving downwardly. When the said rotor blade control is provided on both rotors of the twin-rotor helicopter, the fore and aft or the lateral control can be effected by common periodic variation of the pitch of the blades of both rotors in phase; in the case of fore and aft control the pitch of the blades of both rotors attains a maximum and a minimum value in the position in which the blades are located transversely to the direction of flight, whilst in the case of lateral control the pitch of the blades of both rotors attains a maximum and a minimum value when the blades extend in the direction of flight.

For the purpose of rudder control of the double helicopter according to the invention the blade control may also be utilized by increasing the pitch of all blades of the one rotor and/or reducing the pitch of all blades of the other rotor.

It has not hitherto been attempted to use this kind of rudder control, which is known in the case of helicopters having co-axially disposed rotors, in double helicopters having freely flapping blades, as said control increases the coning angle of the one rotor whilst reducing the coning angle of the other rotor, thus increasing the danger of the blades hitting each other. Careful calculations show however that it is possible also in the case of the said control to avoid the danger of the blades coming into contact.

For twin helicopters according to the invention it should be noted in particular that it is known that a lateral inclination of the plane of the tip circle of the blades occurs when the flying speed increases, (increasing tip speed ratio) in the direction of the side upon which the blades move in the forward direction. The inclination of the planes of the tip circle of the blades of rotors rotating in opposite direction is thus either directed towards each other or away from each other according to their direction of rotation. Both alternatives are undesirable, as in the one case there occurs an unnecessarily large angle between the rotor shafts with a corresponding loss of power and the other case increases or involves the risk of the blades of one rotor coming into contact with the blades of the other rotor.

This drawback can be overcome according to the invention by initiating, by means of the fore and aft control a lateral tilting of both planes of tip circles according to the direction of rotation of the rotors either toward or away from each other. This avoids dangerous tilt positions as the position of the fore and aft control determines the flying speed or the tip speed ratio, which latter causes the undesired lateral inclination.

The particular conditions of stability in a double helicopter according to the invention during the forward flight may in certain circumstances make it appear advantageous to couple the fore and aft control (inclination of the blade tip circle) with the operation mechanism of elevator control surfaces of the usual design, in such a manner that both controls are actuated at the same time, this being ensured by means of a positive coupling.

As the lateral inclination of the tip circles of the blades which has been provided as being suitable involves the risk of the blades of one rotor coming into contact with the blades of the other rotor, it may be found advisable to make the said lateral control effect relatively weak and to so proportion it to ensure hovering or rising without forward movement. For forward flight this control should then be supplemented by the action of lateral control surfaces of the usual design which are operated simultaneously and do not become operative until forward flight takes place. For the purpose of attaching the lateral control surfaces an additional fixed wing should be provided on twin helicopters.

For the purpose of avoiding undesirably large flapping angles when directional control is effected by mutual variation of the blade pitch of both rotors it may be found advantageous to make the available directional control weak, also proportioning it in such a manner that it will be just sufficient to ensure hovering or rising without forward movement. This control should then be supplemented by the action of a directional rudder of the usual design being operated simultaneously but operative only during forward flight.

When it is desired to eliminate ab initio any risk of the blades coming into contact with each other owing to the inclination of the tip circles in the direction toward each other in the case of forward control and when using rotor shafts pivotable in all directions, the common housing mentioned in connection with Figures 13 and 17 and encasing both rotor shafts may be utilized for this purpose, as it is pivotable in all directions with respect to the main driving shaft connecting it to the fuselage. This at the same time offers the advantage that no bending moment can be transmitted from the twin rotor system to the fuselage, when the blade control which for example may be provided is in manner known per se and as hereinbefore described so arranged that such bending moments cannot be transmitted to the fuselage by the control rods.

The free movability of the said housing can however in certain circumstances give rise to oscillation during flight. In this case it may be found advantageous to effect the rotation of the housing in a positive manner by means of a system of rods controlled manually or automatically when variations of the residual torque occur due to the relative angular arrangement of the rotor shafts.

Figure 21 illustrates a front view partly in section of a form of construction of the drive of the twin helicopter according to the invention. There would be a temptation for the purpose of designing a drive to connect the two rotor shafts **10** of the double helicopter to each other by means of a single pair of bevel gearwheels and to the main driving shaft **26**. This method of transmitting the drive would however be unsatisfactory in practice, as helical bevel gears having such a small angle of intersection resulting from the preferred rotative positions of the rotor shafts, are difficult to produce. It is therefore more advantageous in the case of a double helicopter according to the invention as illustrated in Figure 21 to drive the two rotor shafts **10** by means of two pairs of bevel gearwheels **23, 24** from a single shaft **25** extending parallel to the line connecting the two hubs. This shaft **25** is mounted in a housing **213** transversely of the direction of flight, said housing being firmly or, according to Figures 16 and 17, pivotally attached to the fuselage. The common or main driving shaft **26** coming from the engine drives the transverse shaft **25** by means of bevel gearwheels **27, 28**.

Another method of driving the two rotor shafts of a double helicopter according to the invention is diagrammatically illustrated in Figure 22 (in front and side view). In this simplified form of construction the drive of the two rotor shafts is effected by means of intermediate shafts interposed in the manner of universal joints and having each a wormwheel **230** actuated by a common worm **270**, the shaft of which extends perpendicular to the plane in which both rotor shafts lie. The shafts **29** and **30** of the wormwheels **230** extend parallel to the rotor shafts **10**.

In many cases it will be necessary to arrange the engine with a horizontal shaft in the fuselage. In a double helicopter according to the invention the gearing connecting the two rotor shafts to each other may be disposed level with the engine shaft. Figure 23 illustrates diagrammatically a front view of a construction intended to meet this case. The axes of rotation of the rotors are connected by means of the joint shafts **31** and the shafts **100**, which are carried by a gearbox (not illustrated) and extend parallel to the rotor shafts, to the bevel gearwheels 23. The gearwheels **23** mesh (as illustrated in Figure 23) with the gear-wheels **24**, which by means of a further bevel gearing are driven by means of the common shaft **25** of the said bevel gearing. This arrangement is satisfactory as it results in the common, centre of gravity of the aircraft being relatively low so that both stability on the ground as well as stability of the double helicopter in flight are improved. The shafts **100** which are connected to the rotor shafts of the rotors by means of hinged shafts **31** and which are carried in the gearbox must be parallel to the rotor shafts in order to ensure uniformity of drive, which would not be the case when the hinged shafts were each connected to one rotor shaft and the said rotor shaft were not parallel.

Due to the short distance between the two rotor hubs it is possible in a double helicopter according to the invention to enclose both rotor shafts and their bearings in one common streamlined casing lying preferably flush with the contour of the fuselage, as illustrated in Figures 6 and 7. The double helicopter is in this manner given an appearance and the aerodynamic qualities of a helicopter having only one rotor which to a certain extent corresponds to the twin rotors rotating in opposite directions according to the invention.

The constructional forms illustrated in Figures 24–30 and hereinafter described relate to improvements in the hinging of the blades of a helicopter according to the invention. The idea underlying these improvements which offer particular advantages in the case of double-rotor helicopters, are however generally applicable to helicopters having blades which flap freely in flight about flapping hinges and the flapping axes

of which enclose acute angles with the longitudinal axes of the blades. The inclined flapping axes of the blades should preferably point outwardly in the direction of rotation. As is known and as illustrated in Figures 15, 18 and 19, the result of this is the desired interconnection between the flapping angle and the pitch angle of a blade such that the pitch angle diminishes in upward flapping and increases in downward flapping; the degree of this interconnection depends upon the magnitude of the acute angle enclosed by the flapping axis of the blade and the longitudinal axis thereof.

In all rotating wing aircraft (helicopters and auto-rotating gyroplanes) having freely flapping blades, endeavours have always been made to arrange the flapping hinges as closely as possible to the centre of the rotor in order to avoid bending moments on the rotor shaft. Now, when it is desired to fix drag hinges for the blades preferably perpendicular to the flapping hinges, as is known in the case of flapping hinges which are at right angles to the longitudinal axis of the blade, the said drag hinges must be arranged at a certain minimum distance from the centre of the rotor in order to avoid undesirably large angles of lag of the blade. It is therefore an obvious and also usual manner of construction to fulfil the two conditions, viz. minimum distance between flapping hinge and centre of rotor, and at the same time a certain minimum distance between the drag hinge and the centre of the rotor, by arranging the flapping hinge nearest the centre of the rotor and the drag hinge further out in the direction of the tip of the blade. This sequence of the hinges is satisfactory for helicopters in the case of which there are only very slight deflections during flight of the blade at the drag hinge. In the case of helicopters, large angles of lag of the blades occur proportionately with the magnitude of the driving torque. In the case of the aforesaid usual arrangement of the hinges, the angle enclosed by the flapping and the longitudinal axis of the blade increases as the angle of lag increases, and thus the degree of coupling between the flapping angle and the pitch angle of the blades is also altered. This applies also in the case of arrangements in which the flapping hinge is approximately at right angles to the longitudinal axis of the blade and tests have shown that even in this case the smoothness of the rotor is appreciably interfered with owing to the fact that the interconnection between flapping angle and pitch angle varies with the variation of the angle of lag. The relative alteration of the degree of interconnection is therefore the greater, the more acute the angle between the flapping axis and the longitudinal axis of the blade is chosen. But it is precisely in the case of inclined flapping hinges that it is necessary to make the interconnection between the flapping angle and pitch angle independent to the magnitude of the angle of lag of the blades.

This is achieved according to the present invention by arranging a drag hinge between the centre of the rotor and each of the flapping hinges. In this manner the angle ϑ (compare Figure 27) between the flapping axis and the longitudinal axis of the blade is made independent of the drag angle and thus also independent of the driving torque. Where as is usual, special hinges (control hinges) are provided in addition to the flapping hinges and drag hinges between the centre of the rotor and the flapping axes, the blades being adjustable about said control hinges by means of a control, the drag hinges are according to the present invention preferably interposed between the control hinges and the flapping hinges. The theoretical axes of the three hinges of each blade arranged in the sequence according to the present invention may in the case of a suitable constructional form intersect in one point in order in this manner to avoid interference from moments about the control axes.

The axes of the control hinges which serve the purpose of altering the thrust or the position of the circle described by the tips of the blades usually extend in the direction of the longitudinal axis of the blade or approximately parallel thereto. However, according to the present invention the axes of the control hinges should preferably extend almost perpendicular to the longitudinal axis of the blades, because in this case a satisfactory constructional form results even in the case of relatively acute angle between flapping axis and longitudinal axis of the blade.

According to the present invention the drag hinges may be disposed in an inclined position so that downwardly they point in the outward direction. Tests have shown that in the case of a combination of a drag hinge of this kind and an inclined flapping hinge having an axis directed outwardly in the direction of rotation, the coupling of the angles of flapping, angle of lag and pitch is such that friction dampers perpendicular to the blade axis required in the case of drag hinges can be omitted and forces thus avoided in the control.

In the constructional forms illustrated by way of example of this improvement, Figure 24 shows a constructional form in side elevation in the case of a two-bladed rotor, Figure 25 a diagrammatic view of a portion of the control, Figure 26 a vertical section through the control hinge **35** of the constructional form illustrated in Figure 1; Figure 27 is a plan view of the constructional form illustrated in Figures 24 and 26 partly in section through the control axis **35** for various drag angles; Figure 28 a further constructional form in plan view in the case of the three-bladed rotor; Figure 29 a modified constructional form similar to the form illustrated in Figure 28, in side elevation; Figure 30 is a plan view of the constructional form illustrated in Figure 29.

Figure 24 illustrates the arrangements of drive, hinges and controls for the blades of a helicopter rotor having only two blades. In this figure the blades are shown as being broken off the blade roots or spars **70**, whilst in Figures 25 and 26 a portion of the sustentory blade surface **7**, attached to the blade spar **70** may be recognized. The blade roots **70** form axes **8** for a flapping hinge, which is attached at **80** to the forked ends of the arms **500**.

The arms **500** possess a common control hinge **35** by means of which said arms are hinged in the centre of the upper end of the rotor shaft **10**. Said hinge **35** of the control hinge extends almost at right angles to the longitudinal axes of the blades. Each of the two hinges **8**, **80** is mounted between the prongs of the fork of the arms **500** by means of the drag hinge **12**, the rotation of which is damped by dampers **120**. The drag hinges **12** extend at right angles to the flapping axes **8**.

Push rods **43** (Figures 24 and 25), for controlling the arms about the hinge **35** act upon the forked ends of the arms **500** by means of universal joints **34** in a direction almost parallel to the

extension of the drag axes 12. At their lower ends the push rods 43 are connected by universal joints 340 to the arms 42. The arms 42 at the same time each form the axis 45 of a universal joint the other components of which are the intermediate ring 38 and the other axis 44, the latter mounted in the push rod 54 which is arranged longitudinally slidable in the elongated slot of the axis of rotation 10. The universal joint axis 44 is also mounted vertically slidable in the elongated slot 71 of the rotor shaft 10. An up and down movement of the lever 54 effects a uniform alteration of the thrust of all the blades. When the rotor shaft 10 rotates, the universal joint 44/38/45 also rotates. A guide ring 41 is pivotably mounted upon the axes 45 and carries on its lower portion a ball bearing 47. The outer race of the ball bearing 47 lies within a control ring 48 carrying a lever 49 which is retained against rotation about the axis 10 on the fuselage by means of levers not illustrated in the drawing. By means of a control lever 16 the lever 49 may be pivoted in all directions about the universal joint by the pilot. By this means the plane of the circle described by the tips of the blades 70 of the rotor may be inclined as desired.

Figure 27 illustrates in heavy lines the pivoted position of the right blade 7, 70 with respect to the position shown in Figure 26, whilst the non-pivoted position is shown by dotted lines. It will be seen from this figure that the acute angle which the longitudinal axis of the blade encloses with the axis 8 of the flapping hinge is independent of the pivoting movement in both cases.

In the case of the constructional form illustrated in Figure 28 three blades are provided, each being attached to a hub arm 6 by means of a flapping hinge, 8, 80, a drag hinge 12 connected and perpendicular thereto, and a control hinge 35 connected and perpendicular to the drag hinge, the hub arm being rigidly connected to the rotor shaft 10. For the sake of clearness only one blade is shown whilst the other two hub arms 6 are shown as broken off. The hinges are in accordance with Figures 24, 26 and 27 arranged between the fork end of the hub arms 6, in which however not the drag hinge axes 12, but the control hinge axes 35 are directly rotatably mounted. At the end of each control hinge axis 35 there is firmly attached a control arm 88 attached to the control ring by means of a universal joint 34. The control can be transmitted to the control ring 41 in the same manner as in Figures 24–27, which should be connected to the rotor shaft 10 so as to be both pivotable with respect thereto, slidable in the longitudinal axis thereof and rotatable when the rotor shaft rotates. Also in the case of this constructional form the hinge axes of the control hinges 35 extend almost perpendicular to the spar axis of the appertaining blade.

Figures 29 and 30 illustrate a constructional form corresponding to Figure 28 wherein however the drag axis of the drag hinge 12 enclose an acute angle ψ with the spar axis of the appertaining blade 7. The arms 88 for controlling the control hinge (35) in this constructional form are according to Figure 1 connected to the control ring 41 by means of universal joints 34 and push rods 43. The control ring is connected to a universal joint and to a system of control rods 16 in exactly the same manner as described with reference to Figures 24 and 25. The same kind of constructional form of control can also be utilized in the constructional form illustrated in Figure 28, in which for the sake of clearness the said control is not illustrated in detail.

In the case of the arrangement according to Figure 28 it would be quite possible from the point of view of construction to interpose the drag hinge between the control hinge and the centre of the rotor. Said drag hinge would then of course be pivoted simultaneously with the drag movements of the arms 88, so that the universal joints 34 and 340 in Figure 29 would no longer be located perpendicularly above each other and kinomatic errors would occur in the controlling especially in the case of inclined drag hinges (Figure 29). Whilst the improvements developed with the aid of Figures 24–30 refer in the first place to the sequence of blade hinges as arranged in the case of helicopters in so far as said improvements may be of advantage in all helicopters, the constructional forms illustrated in Figures 31–38 are restricted to the arrangements and improvements being applied to double helicopters or twin-rotor helicopters according to the present invention. In this arrangement there is a substantial improvement, independently of the sequence of the blade hinges, namely that the flapping axes of the blades are outwardly directed in the direction of flight and enclose an acute angle with the blade spar axis of the appertaining blade,—even if in the case of a helicopter having only one rotor the said arrangement constitutes no advantage. In the case of the double helicopter according to the present invention this precautionary measure does however, as will be seen from the statements in reference to Figures 15, 18 and 19, facilitate the solving of the problem of avoiding, during starting and landing and also under extraordinary flying conditions, mutual contact between the freely flapping, intermeshing blades of the two rotors.

The constructional forms illustrated in Figures 31–38 relate to control arrangements which are particularly suitable in the aforesaid case, said constructional forms being important in the case of double helicopters also independently of the control arrangement.

The manner hereinbefore described of inclined hinging of the blades is admittedly known in the case of co-axially superposed rotors, but particular importance attaches to said inclined hinging in the case of double helicopters according to the present invention, where it is important on the one hand to limit the range of the flapping movements and on the other hand to maintain the freedom of the flapping movements and to ensure during rotation a uniform thrust also at high ratios of forward speed to tip speed. A thrust which is uniform over the whole rotation is obtained according to the general explanation given at the beginning hereof, by the aid of freely flapping blades. Now, when however the blades are hinged by means of a flapping hinge according to the improvement illustrated in Figures 24–38 uniformity of the thrust also at tip speed ratio is obtained as a result of the flapping movement itself owing to the relative alteration of the angle of incidence, without causing the flapping movement to become too great; in fact where each flapping hinge axis about which the blades oscillate, extends at an angle to the blade spar axis smaller than 90°, there occurs simultaneously with the flapping movement a kinematically produced alteration of the angle of incidence tending to counter-balance the thrust, when the flapping axis is located in

front of the blade spar axis in the direction of rotation.

Figures 31, 32 and 33, 34, 35 and 36 illustrate diagrammatically partly in plan view, partly in side elevation one constructional form each of the improvement whilst Figures 37 and 38 illustrate in perspective and in front elevation the application of the improvement to a helicopter or double helicopter and the controls and drive of the helicopter.

Figure 31 is a plan view of one constructional form; the blade **7** is connected to the arm **6** and the hub **5** by means of an inclined flapping hinge **8**, a control hinge **35** being interposed. The axis of the flapping hinge **8** encloses an acute angle ϑ with the blade spar axis. Owing to the inclined position of the hinge each upward and downward movement of the blade is connected with an alteration of the angle of incidence of the blade. In flight the blade assumes in known manner a position of equilibrium under the action of centrifugal force, inertia and aerodynamic forces. Now, when as a consequence of a gust of wind or the like, there occurs for example an increased upward thrust, the blade flaps upward and at the same time reduces the angle of incidence. This in turn reduces the upward thrust and the flapping movement of the blade is almost brought to a standstill. The control of the rotary blade may be effected by rotating the control hinge axis **35** by the aid of a lever **34**. In this case the hinge may be controlled periodically during rotation (altitude and lateral control) or simultaneously for all blades (directional control, change over from helicopter to autorotating gyroplane). The action of the control hinge is such that the blade flaps about a mean pitch position, which is controlled by the position of the control lever **34**. When for example the ball head of the lever **34** is set low down the result is a large angle of incidence for the mean position of the blade and corresponding increase in the thrust of the blade.

Figures **32** and **33** illustrate a similar constructional form in plan view, wherein however a further drag hinge **12** is provided which is advantageous for the purpose of reducing the moments and forces in the plane of rotation. In the said drag hinge **12** a friction damping device or the like may be incorporated. In this constructional form it is important that the drag hinge **12** be arranged closer to the hub than the flapping hinge **8**. The sequence of the hinges is such that the control hinge **35** is attached nearest the hub, then follows first the drag hinge **12**, and then the flapping hinge **8**. The advantage of this arrangement lies in that the angle between the blade spar axis and the flapping hinge is not altered when the blade oscillates about the drag hinge, so that also in the event of the blade lagging backward the relation between flapping angle and pitch angle remains unaltered once it is set to the position which is found to be satisfactory. By arranging the control hinge nearest the hub kinematic errors of control are avoided.

Figure 32 illustrates for example the conditions in the case of a gyroplane and Figure 33 the conditions in the case of a helicopter. In the helicopter condition the blade lags behind the hub, but the angle ϑ is maintained despite this lagging, and thus also the degree of coupling between pitch angle and flapping angle remains unaltered.

Where circumstances permit (heavy blades, high rotational speed), the angle ϑ may be less acute than illustrated in Figures 30–33. In these cases it is advisable to effect control by rotating the hinges about an axis which as far as possible coincides with the blade spar axis. Such a constructional form is illustrated in plan view in Figure 34. The blade **7** is connected to the control hinge **35** and the hub **5** by means of the flapping hinge **8** and the drag hinge **12**. The control hinge is located in the extension of the blade spar axis and is cyclically or simultaneously adjusted by means of the lever **34**.

In order to avoid vibrations due to the flapping movements of the blades being transmitted to the hub or to the control, a further flapping hinge **28**, may be provided further out along the blade. This hinge also has the considerable advantage that the maximum movement permitted by the main hinge **8** may be still further reduced so as to allow movements to be carried out only about the auxiliary hinge **28** for example in the case of heavy loads (strong gusts of wind). By choosing an acute angle between the auxiliary hinge **28** the blade spar axis in the same manner as between the main hinge **8**, a very great reduction in upward thrust can be coupled to the flapping angle, so that no great stresses occur at the inner portion of the blade even when the rotation about the main hinge **8** outside the normal range of rotation is limited by means of a stop.

The constructional form illustrated in Figure 35 (side elevation), and in Figure 36 (plan view) has the advantage that bulky component parts such as friction dampers may be omitted; by inclining the drag hinge **12** to an angle of ψ and having suitably chosen the rotary blade conditions, it is possible to obtain a damping of the drag movement, without the necessity for providing additional friction dampers. As a result, the constructional height of the hinge may be reduced. Further advantages are gained in that by suitably choosing the inclination of the hinge and the distance from the axis, an automatic alteration in the angle of incidence is effected, namely in that when driven, the blade lags and increases the angle of incidence. In the same manner the angle of incidence would automatically be adjusted from that of a helicopter to that of gyroplane as soon as the motor drive breaks down or is throttled back. The essential and also hitherto unknown point is that the inclined drag hinge **18** is nearer the hub than the flapping hinge **8**, as in that case the angle ϑ is independent of the driving torque.

Figure 37 illustrates diagrammatically a helicopter arrangement with the appertaining control arrangement for the adjustment of the pitch angle of the blades. The figure illustrates only one rotor hub (5) having two blades only partly drawn: however the control device is arranged so as to act upon the blades of two rotors which may be disposed with respect to each other according to the invention.

On the control hinge axes 35 which are rotatably mounted in the hub 5, there are located rigid and bent control arms **880**. Two push rods **43** act upon the said control arms by means of universal joints **34** the lower ends of the said push rods being connected to a rod **410** by means of universal joints **52**. The rods **410** constitute a portion of the outer Cardan ring **41**, which together with the two pins **440** and **420** and the inner Cardan ring constitutes a universal joint pivotable in all directions. The axis **420** passes through longitudinal slots **71** in the rotor shaft **10**

and is entrained by the rotor shaft when the latter rotates. The drive of the rotor shaft 10 is not illustrated. The axis 420 is mounted in the push rod 54 so as to be slidable together with the latter in the longitudinal direction of the rotor shaft 10.

The Cardan ring 41 possesses a collar 460 upon which a further control ring 43 acts by means of a ball bearing 47. The control ring 48 is connected to the control rod 49 by means of a joint 53. The parts just described of the control arrangement, with the exception of the rod 49, are symmetrically duplicated in the case where a second rotor is to be simultaneously controlled, whilst the rod 49 and the controlling parts about to be described are common to both rotors.

In the centre of the rod 49 there is mounted by means of a universal joint 55 a control rod 490, the upper end of which is joined by means of a universal joint 56 to a fixed part 57 of the fuselage. The lower end of the control rod 490 is connected by means of a universal joint 58 to the usual control lever or stick 16. Said lever 16 is pivotably mounted at 59 in a fork-ended part 72, which at one end is rotatably mounted at 63 in a direction perpendicular to the direction of the drag hinge 59 and of the lever 16. The bearing 63 is located in a part 64 firmly attached to a shaft 61 which is rotatably mounted in two fixed parts 62 of the fuselage.

The fixed parts 62 of the fuselage further constitute a bearing for a shaft 69 to the ends of which fork pieces 67 are keyed. The split ends of the fork pieces 67 encase pins 66, projecting from the outer portion of a thrust bearing 65, by means of the inner portion of which the rod 54 is rotatably mounted.

A control lever 68 sets upon the shaft 69 at one of the fork pieces 67, the said lever enabling the fork ends to be pivoted about the axis 69. During such pivoting movement of the lever 68 the rod 54 is displaced in the longitudinal direction with respect to the rotor shaft 10, the rod 420 being at the same time displaced in the direction of the slots 71; at the same time the push rods 43 are also thereby displaced and the control lever 880 together with the control axes 35 are rotated.

The control lever or stick 16 makes it possible, as will be seen, by means of the control arrangement described, to effect a pivoting of the blades 7 in opposite direction for any desired point of the path of rotation in such a manner that this adjustment is maintained for each point of the path of rotation and continues to recur cyclically during the rotation. In this manner the position of the described tip-circle-disc is controlled. The same applies at the same time to the second rotor which may be connected to the system of control levers.

The lever 68 further makes it possible to pivot all the blades of one or both rotors in the same direction in such a manner that this adjustment is maintained in equal measure through the entire rotation of the blades, independently of the adjustment which the lever 16 may superpose thereon. In this manner the lever 68 serves to alter the thrust of one or both rotors.

Figure 38 illustrates partly in section a front elevation of a double helicopter wherein the control arrangement according to Figure 7 has been provided for both rotors; the system of control rods attached to the joint 55 of the control rod 49 which is common to both rotors has been omitted for the sake of clearness, only the links 580, 160 for guiding the control being illustrated in this figure.

The two rotor shafts 10 are mounted in a common housing 130, containing the driving gear for the rotor shafts. This driving gear consists, as illustrated in Figure 21, of a pair of bevel gearwheels 23 keyed to the rotor shafts and engaging a pair of bevel gearwheels 24 both of which are firmly keyed to a shaft 25. On the said shaft there is keyed a bevel gearwheel 28 engaging a bevel gearwheel 27, which in turn is firmly keyed to a shaft 72 mounted in the housing 130, and connected by means of a universal joint 73 and a further shaft 74 to the driving motor which is not illustrated in the drawing. The said driving motor is located in the fuselage 75 which is adapted to taxi on the ground by means of an undercarriage 76 with carrying wheels 77.

The constructional form illustrated in Figures 39–46 represents a further improvement upon a double helicopter according to the present invention. The improvement provides other means than the means illustrated in Figures 24–38 for meeting cases in which owing to the use of freely flapping blades or blades oscillating about an inclined or virtually inclined hinge, there occur during the starting or braking of the rotors, instances in which the relative wind or a gust of wind would force individual blades upwardly or downwardly. This might occur especially where the rotors are rotating at a low speed of revolution, namely while the centrifugal force is still below a certain minimum value. In these cases there may thus be a risk that the blades of one rotor would come into contact with the blades of the other rotor.

It is the object of the improvement especially in such cases to arrest or to limit the flapping or oscillating movements and if desired also the drag or control movements of the blades about the hinges concerned. Such a limitation or arresting of the blade movements while on the ground or when starting or braking the rotors, that is to say at low speeds of rotation, has been proved to be advisable also for the purpose of enabling other parts of the aircraft (such as the undercarriage, control screws or the like) to be disposed nearer to the rotor blade planes of rotation, or for reducing the height of the aircraft and increasing ground clearance.

According to the improvements these aims are reached owing to the fact that the movements of the flapping and/or drag and/or control hinges are separately or simultaneously limited manually or by centrifugal force by means of stops controlled by mechanical, electrical, hydraulic or pneumatic controlling means, which when a certain rotational speed is exceeded or in the case of manual operation allow complete freedom in the range of movement.

Figure 39 illustrates in side elevation a stop controlled by centrifugal forces. The blade spar 70 is hinged by means of the flapping hinge 8 and the drag hinge 12 to the fork end 79 of the hub arm 6. Before the commencement of a flight there is located between the blade spar 70 and the stop of a hinge part 78 connected to the hinge axis 12, a pair of rollers 84 attached to a link 83 which is hinged at 86 to the blade spar 70. The link 83 guides a roller 85 which in the position of rest is located between fork-shaped stops 87 of the fork end 79 and 91 of the hinge part 78, the latter possessing a damper 120. (Only the rear fork parts of the stops 87 and 91 are visible on the drawing.)

Figure 40 illustrates the T-shaped arrangement of the rollers 84 and 85 which for the sake of clearness are shown in perspective. The rollers 84 (Figure 39) prevent the blade from failing to reach a certain flapping angle; whilst the roller 85 limits the drag movement in the desired manner. As the rotational speed increases during starting, the centrifugal force of the parts 83, 84, 85 increases until it is sufficient to release the hinges. The parts then assume the position shown in dotted lines, in which the rollers 84 impinge upon a stop 92 of the blade spar 70. This position is maintained during flight until the rotor is braked after landing and falls below a certain speed of rotation in which whereupon the stop rollers again enter between the hinged parts.

In order to ensure simultaneous release of all blades during starting it will be found advisable after reaching a certain speed of rotation to throttle the engine for a short moment or to disengage it from the rotors, as this will relieve the rollers 84, 85 of load so that their friction upon the stops ceases and they are free to move outwardly.

Figure 41 (side elevation) illustrates another stop controlled by centrifugal force. In this case two rollers 840 and 850 constituting a T-shaped arrangement are in a manner similar to the stop illustrated in Figure 39 pushed in between the flapping hinge 8 and the drag hinge 12 in the position of rest. In order to attain greater actuating force there is arranged at a greater distance from the axis of rotation 10 of the rotor, in certain circumstances within the section of the blade 7, a weight 94 upon a push rod 93, also carrying rollers 840, 850. A spring 89 which forces the roller 840 and the push rod 93 inwardly and bears against a shoulder 98 of the blade spar 70, is so proportioned that the rollers 840, 850 do not release the stops 87, 91 and thus allow complete freedom of movement until a pre-determined speed of rotation has been reached.

Figure 42 (side elevation) illustrates a stop for the flapping hinge 8 in the form of an eccentric. The blade spar 70 rests upon a lip 789 of the hinge part 73, an eccentric 95, 96 being interposed. The eccentric axis 95 is rotatably mounted in the fork end of the blade spar. The eccentric proper 96 is rotated through 90° or less by means of a push rod and link 930, as soon as the centrifugal force of a weight 940 overcomes the force of a spring 890 interposed between a collar on the rod 930 and a part 980 attached in the blade spar 70, which spring pushes the rod 930 inwardly. In this manner the range of movement about the periphery of the eccentric is increased, that is to say the blade is practically allowed complete flapping freedom.

The eccentric may also be so designed, if desired, as to be controlled by the pilot.

The stops controlled by centrifugal force or by any desired means (84, 85, 840, 850, 95) may in appropriate manner be applied also to inclined flapping and inclined drag hinges, for example hinges as utilized in the constructional form illustrated in Figures 31–38.

Figure 43 (side elevation) illustrates such an arrangement. Both the flapping hinge 8 as well as the drag hinge 12 are in this case arranged in an inclined position with respect to the blade spar axis 70. The rollers 840, 850, arranged so as to constitute a T push themselves owing to the force of the spring 890 in between the hinge stops in a manner similar to the rollers in the previous arrangements, of which stops only the stop 87 being illustrated in the drawing for the sake of clearness. The spring 890 which on the one hand bears against the transverse member 99 of the push rod 930, and on the other hand against the part 980, is already counter-balanced by the centrifugal force of the weight 940 at low speeds of rotation.

The rollers 840 and 850 are preferably domed or spherical; in the same manner the faces of the stops may be conical to suit the movements about the hinges.

Figure 44 (side elevation) illustrates the design of a stop 101 controlled by centrifugal force for limiting the flapping movements of two oppositely arranged blades. The constructional form of the hinging of the blades corresponds to the main claim of the cited German patent 567,584 (Bréguét). The hub arms 60 are hinged to the rotor shaft 10 at 80. On the arms 60 there are located the control hinge axes 35 at the outer ends of which a universal joint 12/8 is located, to which the blade spar 70 is connected. The control lever 88 of each control hinge 35 is controlled by means of swash plates 41, 48, a push rod 43 (Figure 6) being interposed. The restricting of the flapping movement is effected by means of a lock 102 which under the action of a spring 103 tends to push in between the lips 104 of the arms 60 and thus locking the movement of the arms 60 and the hinge 80 when the speed of the rotation is low.

At higher rotational speeds, the centrifugal force will however tend to raise the weight 101, so that the angle lever 105 causes the lock 102 to be released, a hinge part 106 being interposed. The hinges 8 and 12 may as in the case of the previously described constructional forms also be provided with adjustable or controllable stops.

It is generally desired, when starting and slowing down the rotary blades, that the upward coning angle of the blades shall as far as possible remain the same as in normal flight, and for this purpose there is according to the present invention preferably provided a system of control for the stops such that an auxiliary force, raising the blades, is imparted to the blades as the rotational speed thereof decreases. As a lifting force any known power transmission (spring force, compressed air, oil pressure, electric drive or the like) may be utilized. The source of energy may be an external source (engine, compressed air cylinder, etc.). It is however also possible to release the energy required for raising the blades from a stored centrifugal force automatically when the rotational speed decreases, so that beyond the energy required for driving the rotor no other external energy need be supplied.

Figures 45 and 46 illustrate two constructional forms of automatic blade raisers of the kind just described, in side elevation.

Figure 45 illustrates a device working by means of oil pressure and compressed air. The blade 71 is supported upon a projection 187 on the drag hinge 12 by means of a cylinder 107 which is under oil pressure and a piston 108, and a pressure roller 184. An oil line 109 connects the second cylinder 107 to a cylinder 111, located near the blade tip. The cylinder 111 has a relatively small diameter and large stroke compared with the cylinder 107. A piston 112 which is at the same time a centrifugal weight closes the oil pressure cylinder 111 tightly against a compressed

air cylinder **113**. The compressed air cylinder can be filled by means of a valve **114**. In flight the piston **112** is centrifuged outwardly against the air pressure so as to impinge upon a shoulder in the cylinder, so that the said piston cannot produce an out of balance condition by its movement. The oil piston **108** is then in its upper position and releases the stop **184**, **187**. When a certain rotational speed is reached during the slowing down, the air pressure in the cylinder **113** preponderates and the piston **112** travels inwardly and presses the piston **108** down, thus causing the blade to be raised to the desired coning angle. When starting, the process is repeated in the reverse sequence.

Figure 46 illustrates a corresponding arrangement which however works purely mechanically. In this case the lifting process is produced in similar manner, except that instead of compressed air, a spring **189** serves the purpose of storing energy. Instead of the oil pressure transmission, use is made of a mechanical transmission, consisting of a push rod **193**, the rollers **115** between inclined faces, the wedge lever **116** and the pressure rollers **184**. The centrifugal weight **194** is located on the extension push rod **193**. The constructional forms illustrated are merely examples, and combinations of mechanical transmissions and compressed air storage or combinations of oil pressure transmission, and spring energy storage or the like may be used alternatively. Instead of the wedge lever **116** wedge **102** as illustrated in Figure 44 or an eccentric **95**, **96** as illustrated in Figure 42 or rollers **84**, **85** or **840/850** as illustrated in Figures 39 and 41 and 43 are also feasible in which cases also the remaining stops of the drag and control hinges may be controlled either directly or by means of remote control from the energy storing member. The use of the arrangements mentioned is also possible in the case of inclined flapping and inclined drag hinges (Figure 43) and also for a larger number of flapping hinges (Figure 44).

Instead of the controlled stops, rollers, wedges and/or stop surfaces according to the present invention use may alternatively be made of resilient substances or shapes, which allow of resilient deflection, in order that the impinging upon the stop surfaces may be as gentle as possible.

The arresting of the hinges (control hinges) which are usually movable about the blade spar axis and controlled by the pilot or automatically, may alternatively be effected by means of centrifugal stops. It is preferable to have all the stops of one blade controlled by means of the same weight.

Safety devices such as electromagnets, Bowden cables and the like may also be provided for the purpose of releasing the stops of all the rotary blades simultaneously; in the operative position these safety devices must ensure that the stops are retained in their working position.

The use of the basic idea and the details of the last described improvements is as may be seen also possible in the case of single rotors not combined in twin-rotor helicopters and in case of need they may be extended with advantage to such twin-rotor helicopters, in particular to helicopters of the constructional forms illustrated in Figures 23–30.

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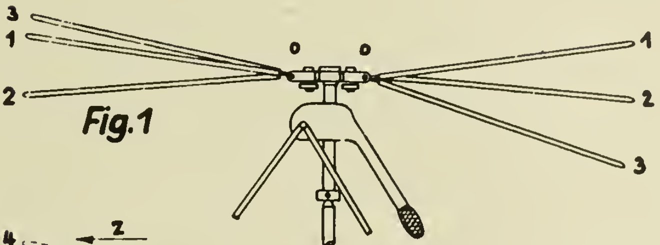


Fig.1

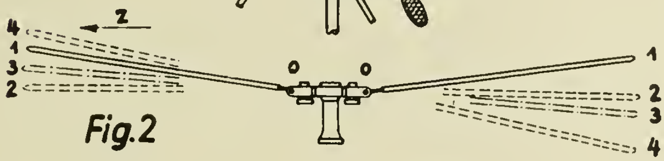


Fig.2

Fig.3

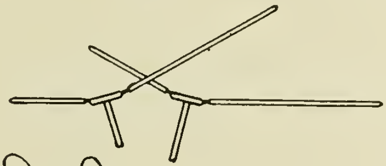
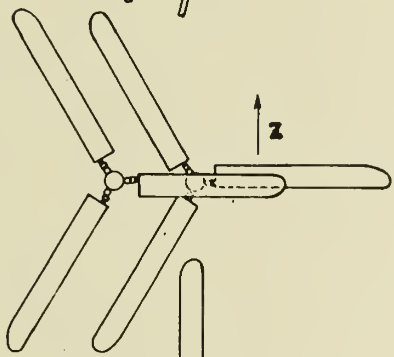


Fig.4



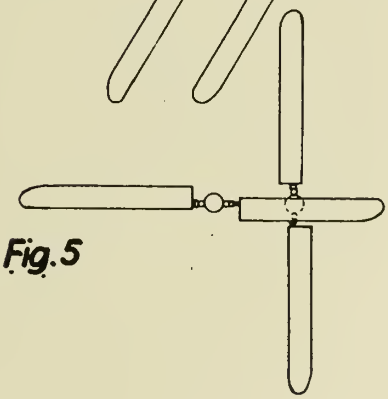


Fig.5

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Fig.6

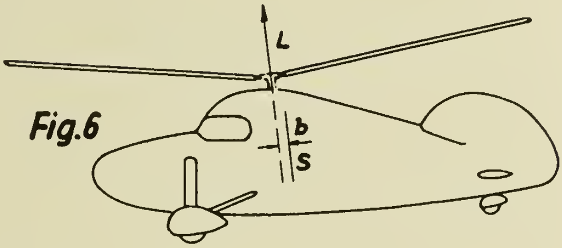

Fig.7

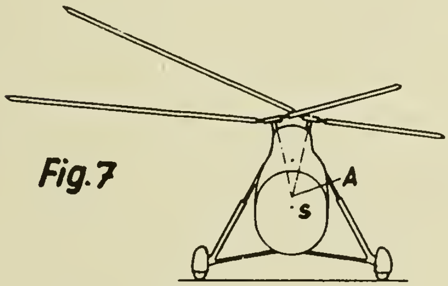

Fig.8

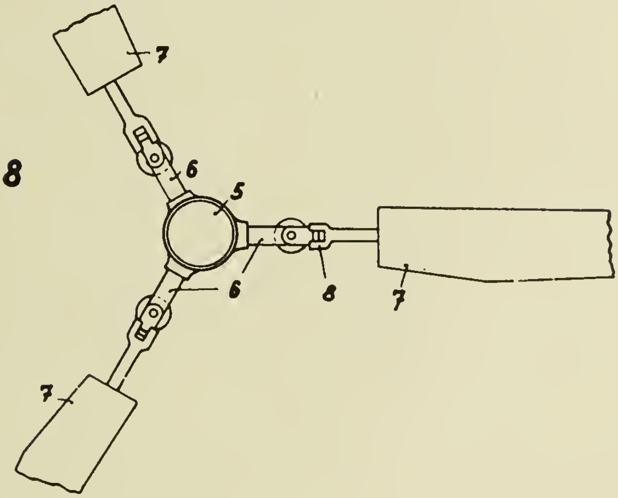

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Fig.9

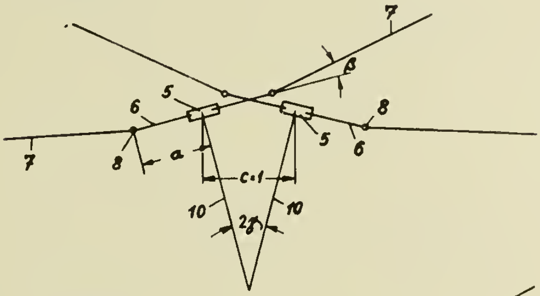

Fig.10

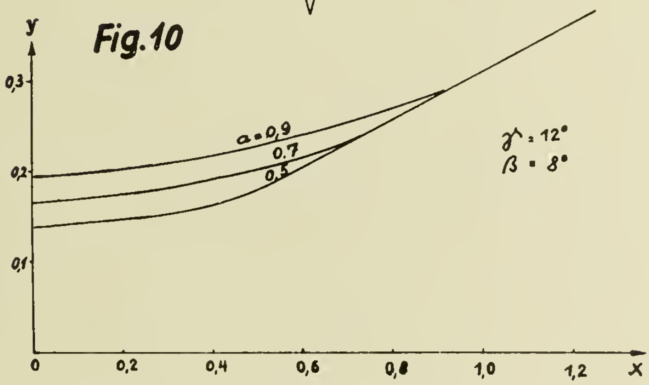

Fig.11

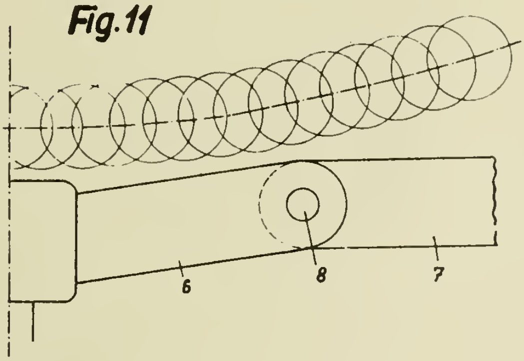

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Fig.12

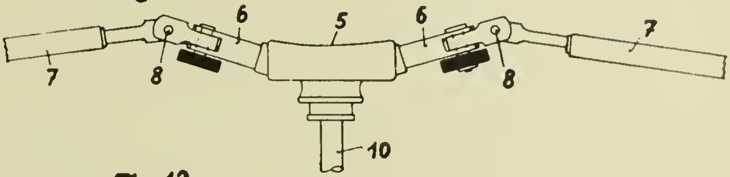

Fig.13

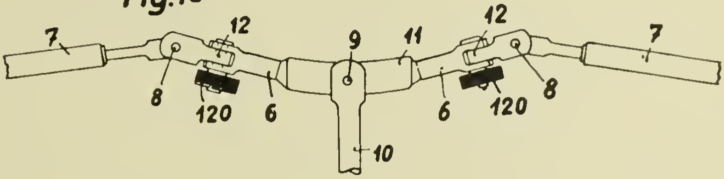

Fig.14

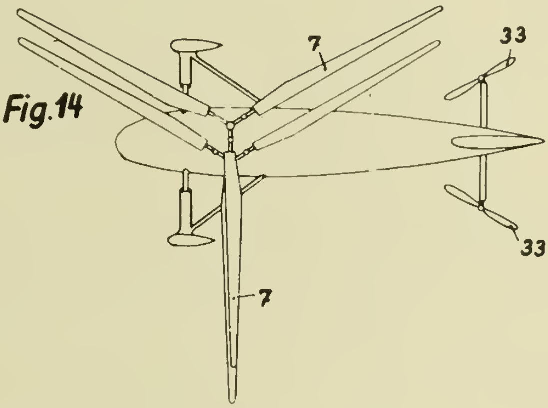

Fig.15

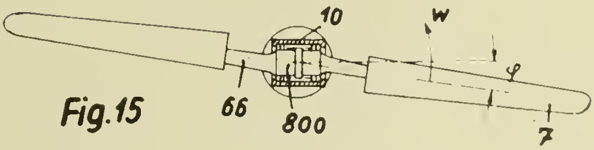

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Fig. 16

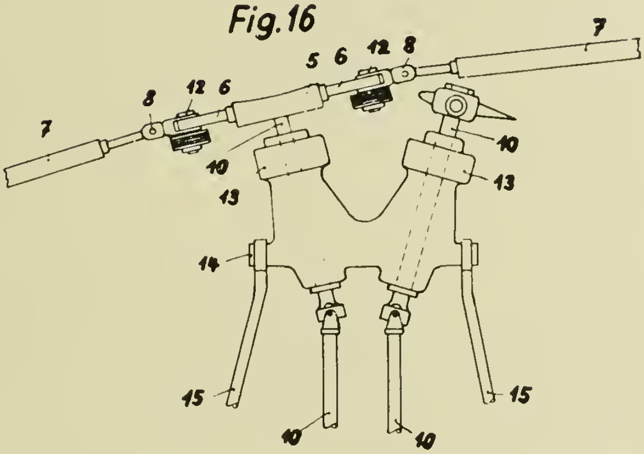

Fig. 17

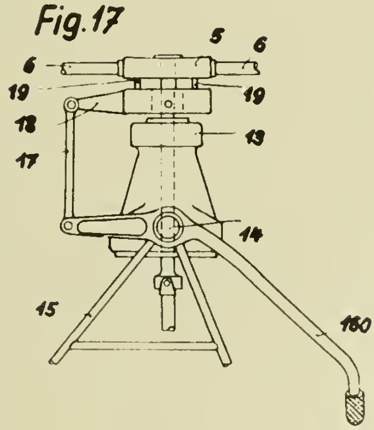

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Fig.18

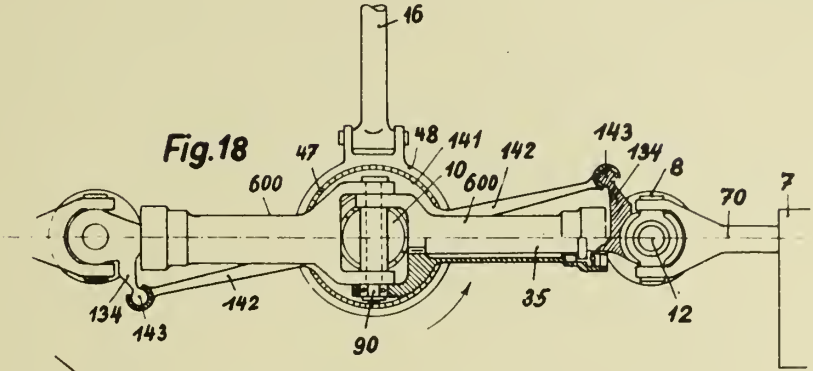


Fig.19

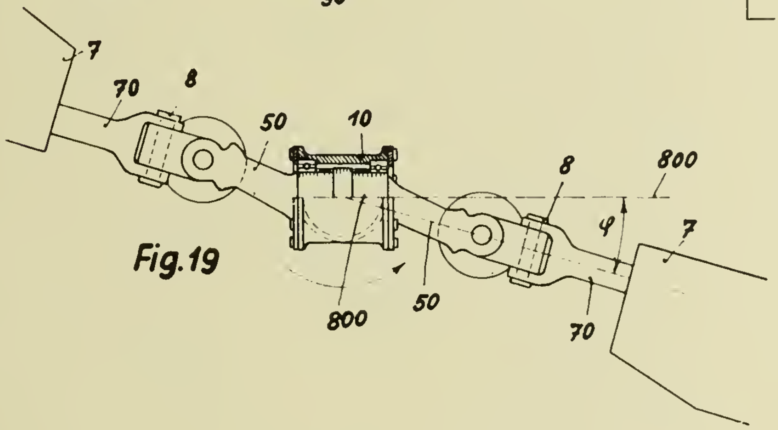
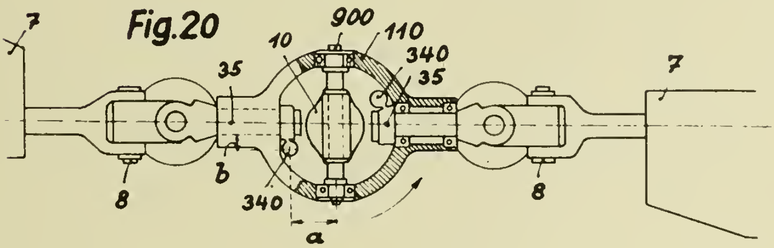


Fig.20



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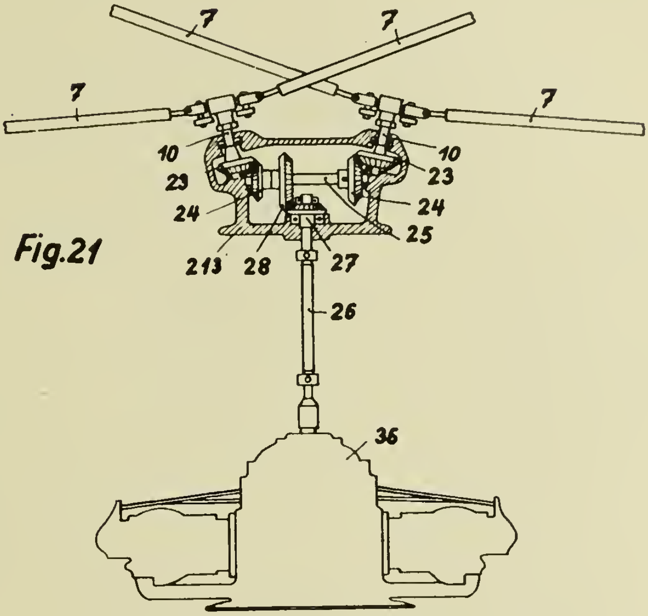

Fig.21

Fig.22

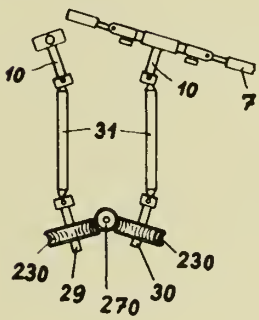

Fig.23

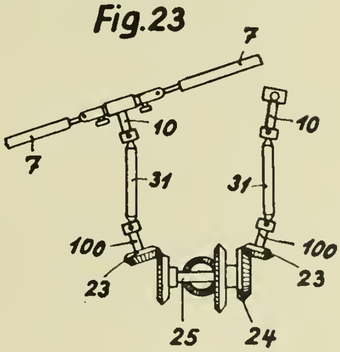

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Fig.24

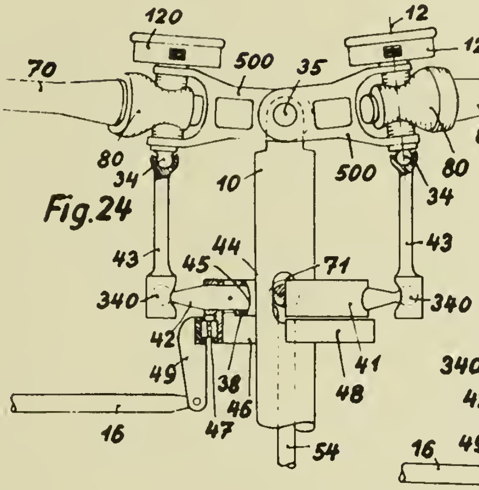

Fig.25

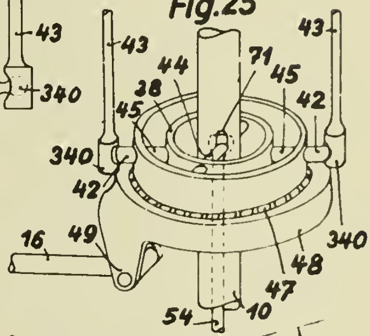

Fig.26

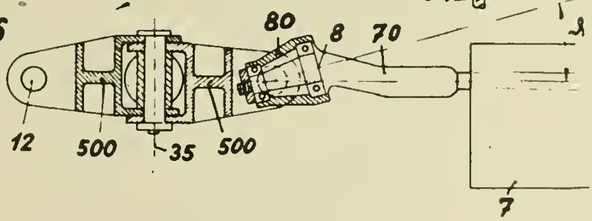

Fig.27

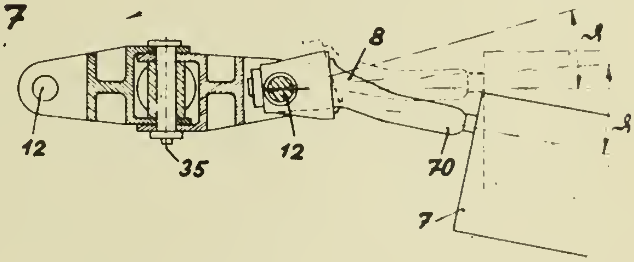

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Fig.28

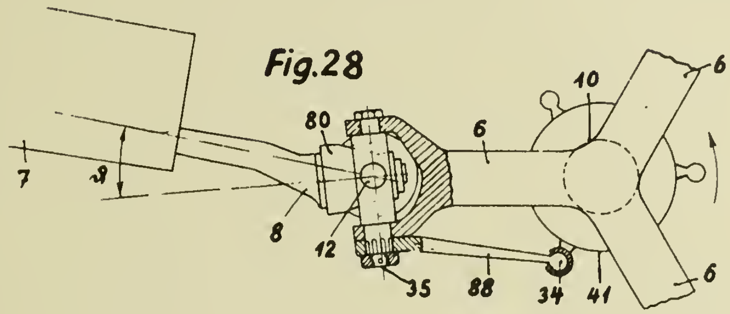


Fig.29

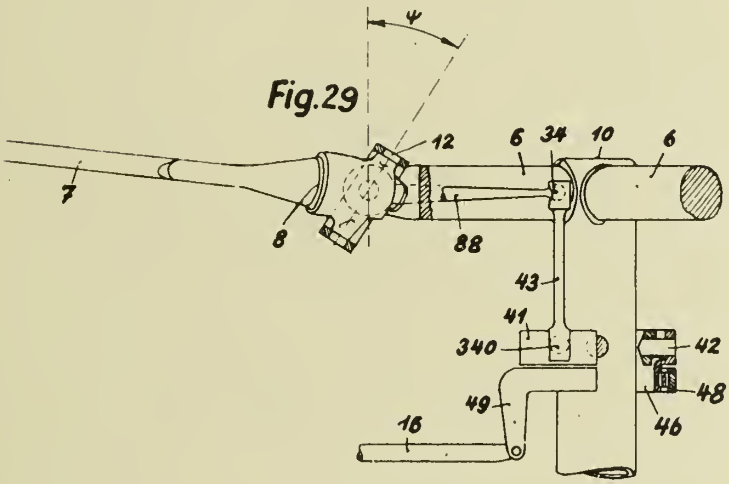
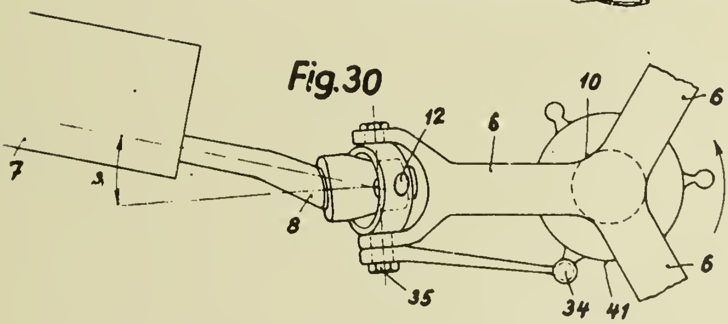


Fig.30



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A. FLETTNER

HELICOPTER HAVING TWIN INTERMESHING ROTORS

Filed Feb. 6, 1939

Serial No. 254,867

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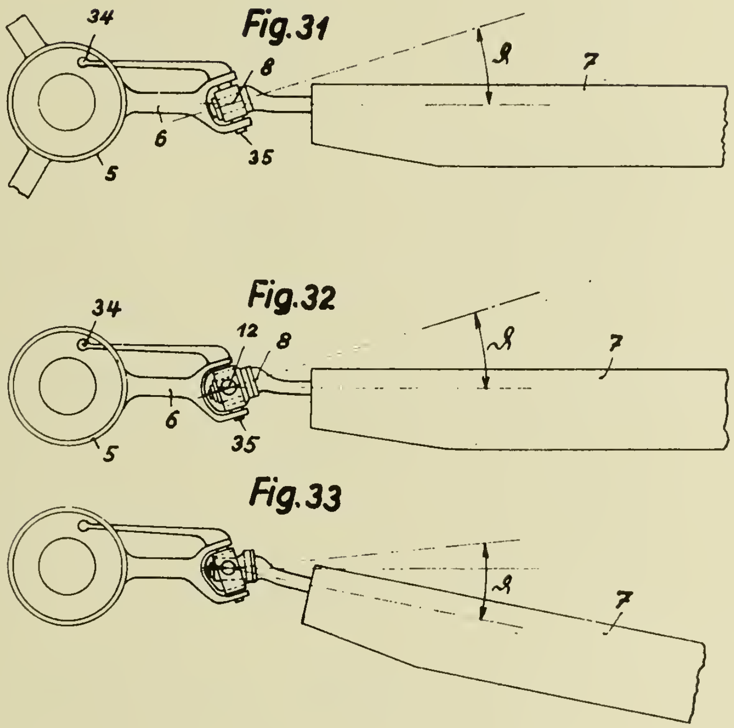

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MAY 25, 1943. HELICOPTER HAVING TWIN INTERMESHING ROTORS 254,867

BY A. P. C. Filed Feb. 6, 1939 15 Sheets-Sheet 11

Fig.34

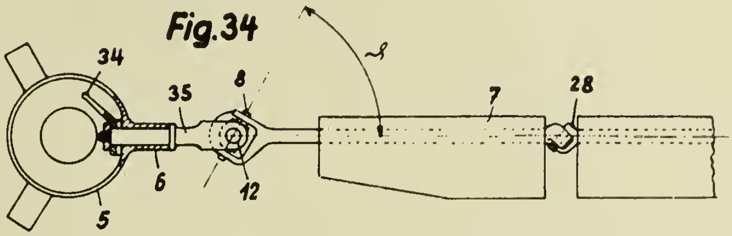


Fig.35

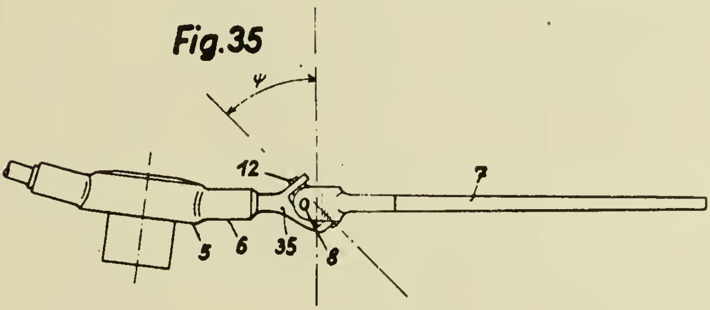
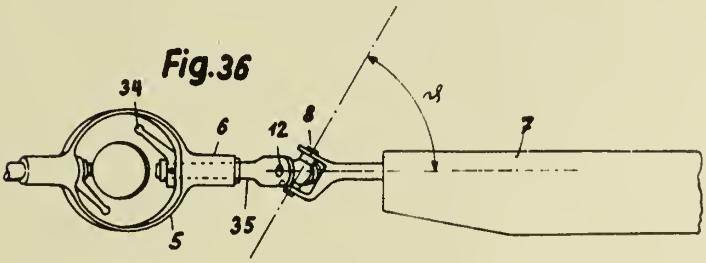


Fig.36



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MAY 25, 1943. HELICOPTER HAVING TWIN INTERMESHING ROTORS 254,867

BY A. P. C. Filed Feb. 6, 1939 15 Sheets-Sheet 12

Fig. 37

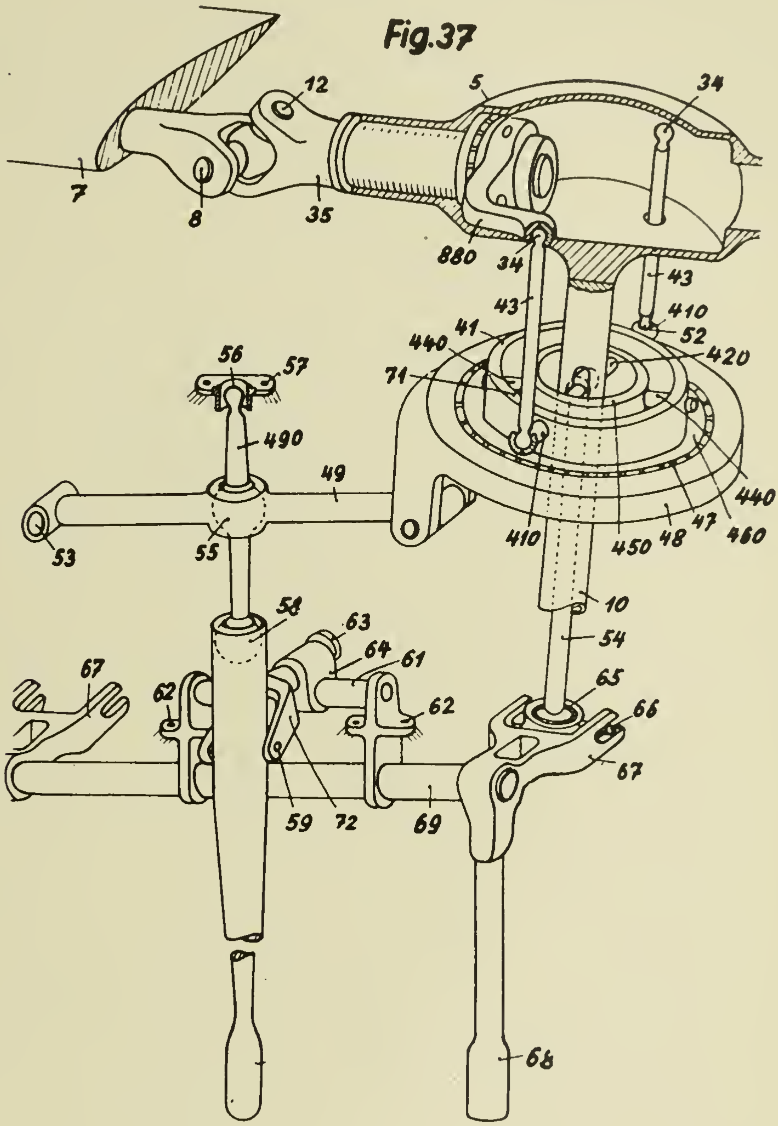

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Fig. 38

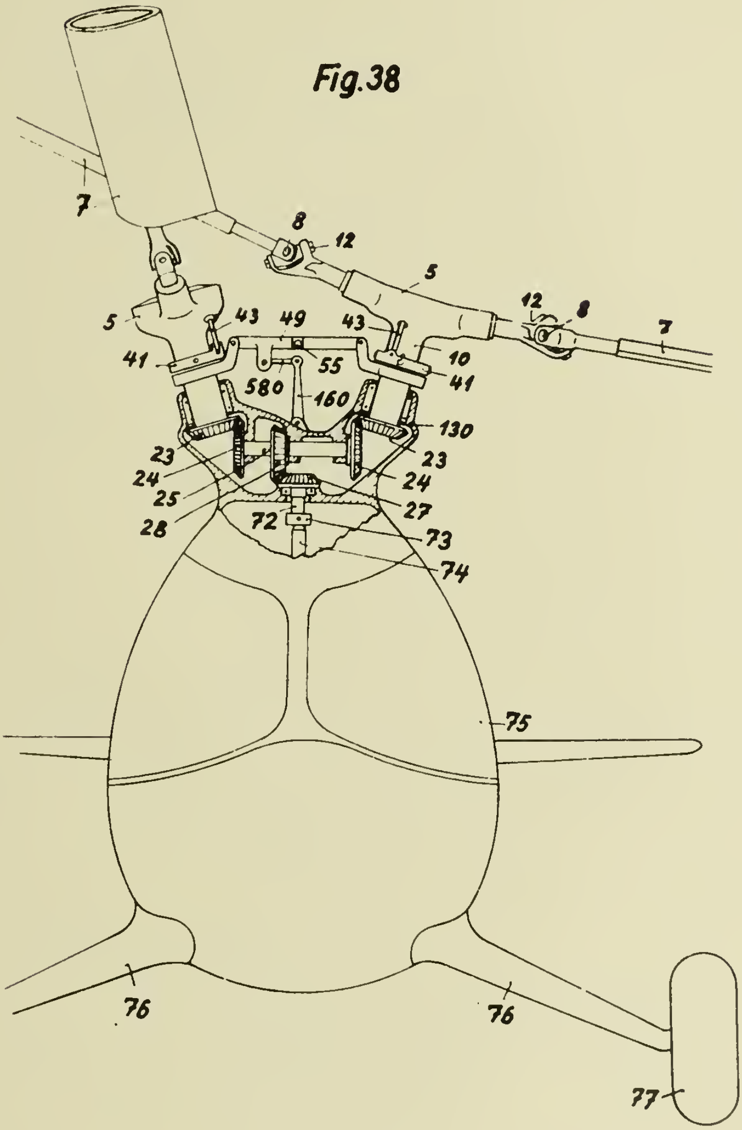

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Fig. 39

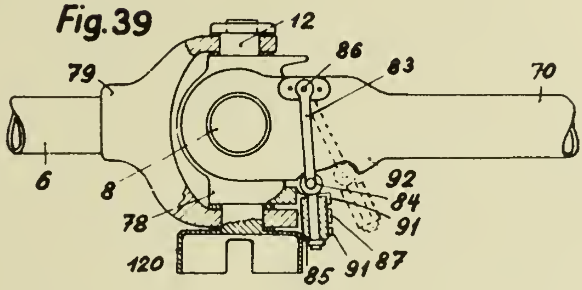

Fig. 40

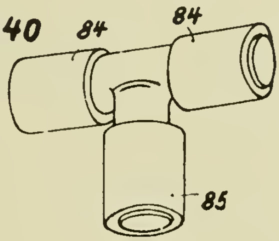

Fig. 41

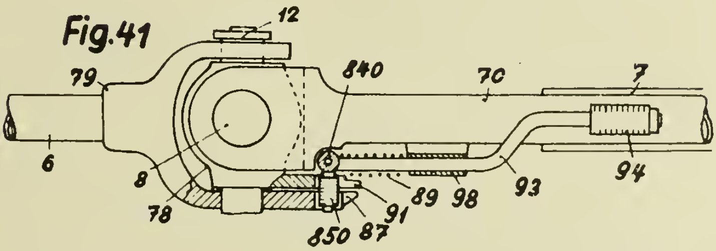

Fig. 42

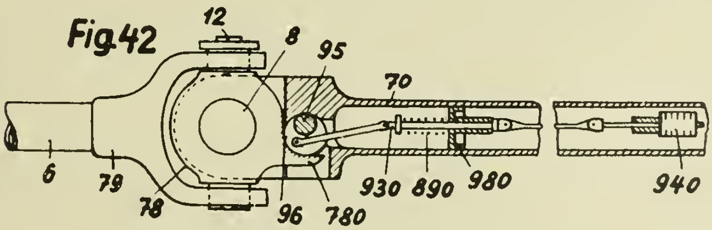

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Fig.43

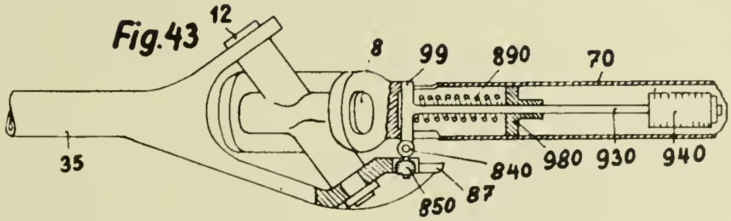


Fig.44

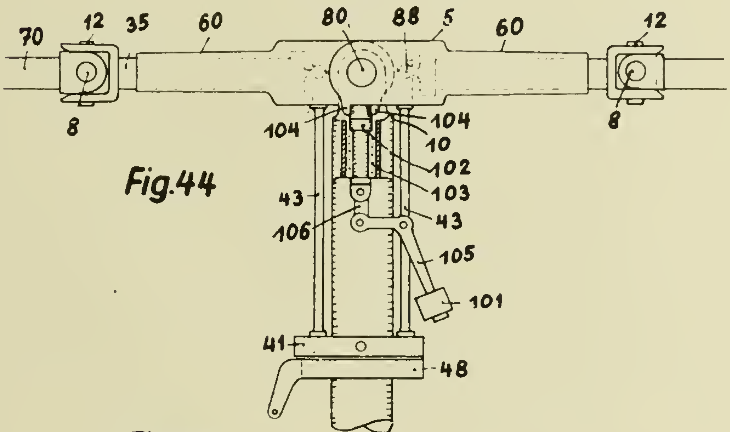


Fig.45

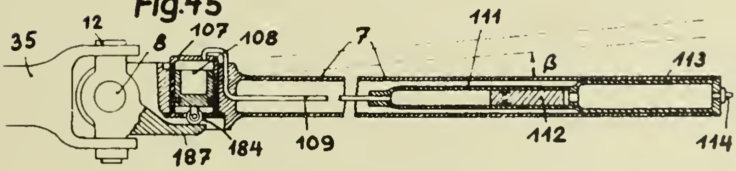
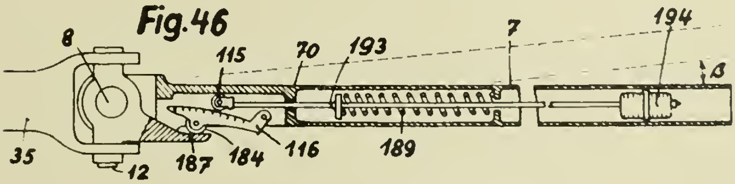


Fig.46



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ALIEN PROPERTY CUSTODIAN

INSTRUMENTS FOR SUPERVISING THE RUNNING OF POWER DRIVEN VEHICLES

Paul Riegger, Villingen, Black Forest, Germany; vested in the Alien Property Custodian

Application filed February 21, 1939

The heavy stresses imposed on vehicle engines when running for long periods, for example when the vehicle is travelling along a motor road, easily lead to excessive strain on the engine and therefore to its becoming worn out prematurely. Therefore, in the interests of maintaining reliability of operation and also for keeping the engine in good running order, as long as possible, it is desirable that the speed of revolution of the engine and also the driving of the vehicle should be carefully supervised.

Revolution counters for indicating the speed of the engine are well known. They have the disadvantage, however, that they only indicate the revolutions at a particular time and do not record them. On the other hand, the recording of the engine speeds in addition to recording the speed of the vehicle would complicate the recording apparatus very considerably and increase its cost.

Now the present invention provides an apparatus whereby the times when the speed of revolution of the engine becomes excessively high and the duration of the periods of excessive engine speed are recorded, in addition to the speed of travel of the vehicle. The invention is therefore concerned with improving the known instruments for supervising the operation of power vehicles of the kind in which the speed of the vehicle at any time is recorded on a chart which is moved by a clockwork mechanism. According to the present invention, the instrument is also provided with a stylus which records continuously on the chart and, as soon as a predetermined maximum engine speed is exceeded, is moved in a direction which differs from the direction of movement of the chart by means of a controlling device which is responsive to the speed of revolution of the engine. In this way the construction of the apparatus is considerably simplified.

In order that the invention may be readily understood and carried into effect two forms of instruments constructed in accordance with the invention are illustrated diagrammatically and by way of example in the accompanying drawings, in which

Figure 1 shows an instrument provided with a static centrifugal pendulum, whereas,

Figures 2 and 3 show in side elevation and plan respectively part of an instrument provided with an astatic pendulum.

Referring to Figure 1 of the drawings, a circular chart 1 is provided with a time scale 2 and is rotated in the sense indicated by the arrow x by the spindle 3 of a clockwork mechanism which is not illustrated in the drawing.

A stylus 4 which co-operates with a central recording zone of the chart records the speed of the vehicle provided with the apparatus relatively to the time indicated on the chart. A part of this record is indicated at 5. Instruments of this kind are well known.

For actuating the stylus 4 the following device is employed.

A shaft 6 which is coupled to the wheel axle of the vehicle carries a weight 7 which rotates together with the shaft 6 and is also capable of swinging about a pivot 8 at right angles to the shaft 6. The weight 7 is connected by a rod 9 to a rack 10 which is in the form of a body of revolution which rotates with the shaft 6 but can also be shifted longitudinally. A spring 11, which is arranged on the shaft 6 between the pivot 8 on which the weight 7 turns and the rack 10, tends to hold the rack 10 and the weight 7 in the upper end position which is illustrated in Figure 1 of the drawings.

A pinion 12, on the spindle 13 on which is mounted a pinion 14 of larger diameter meshes with the rack 10. The larger pinion 14 meshes with the teeth on a slidable member 15 which carries a stylus 14 and is longitudinally displaceable on a slide bar 16.

When the vehicle fitted with the instrument is moving the shaft 6 rotates. The centrifugal force acting on the weight 7 tends to swing the weight against the return force of the spring 11 about its pivot 8 in the direction of the arrow y. The rack 10 which is longitudinally displaceable on the shaft 6 follows this movement of the slide 15, with the result that the slide 15 and therefore the stylus make a corresponding movement in an upward direction. As the speed of travel increases, that is to say the speed of revolution of the shaft 6 becomes greater, the weight 7 is swung more and more into the horizontal position, the spring 11 being compressed, and the stylus 4 is moved upwardly more and more over the chart 1. Since the chart is simultaneously driven in proper time by a clockwork mechanism which is not illustrated, a time-speed curve 5 is recorded on the chart from which it is possible accurately to determine at what speed the vehicle was moving at any given time.

Instead of the centrifugal weight 7 which is illustrated in the drawing, any other controlling apparatus which responds to variations in the speed of the shaft 6, for example a differentiating revolution meter, can be employed in order

to move the stylus 4 over the chart 1 in accordance with the speed of travel of the vehicle.

A second stylus 18 which is carried by a lever 20, 21 which is fulcrumed about an axis 19 coacts with the outer strip 17 of the chart 1. The arm 20 of the lever 20, 21 is acted upon by a spring 22 which normally presses it against a stop 23. The other arm 21 of the stylus lever carries the armature 24 of an electromagnet 25, the ends of the coils of which are connected respectively by the conductors 26 and 27 through a source of current 28 to a contact 29 and to a double-armed contact lever 31, 32 which can turn about a pivot 30. The contact lever 31, 32 is normally held by a spring 33 which acts on the arm 32 in the open position in which it bears against a stop 34, which position is illustrated in the drawing. The spring 33 also engages the free end of the lever 35 which can turn about a pivot 36 and is held by means of a spring 37 against a controlling pin 38. This controlling pin 38 is disposed in a longitudinal bore in a shaft 39 which is connected to a rotating part of the vehicle engine, for example its crankshaft or camshaft.

A centrifugal weight 40 which can swing about a pivot 41 at right angles to the shaft 39 is provided on the shaft 39 in the manner usual in speedometers. The weight 40 is connected by a rod 42 with the controlling pin 38 which can be moved in the bore of the shaft 39 and is held in the position illustrated in the drawing by means of a spring 43 as long as the centrifugal force acting on the weight 40 does not overcome the power of the spring 43. The other end of the spring 43 is fixed to an adjusting ring 44 which is adjustable on the shaft 39 so that the tension of the spring can be regulated.

If the speed of revolution of the shaft 39 exceeds a predetermined value which corresponds to the highest permissible speed of revolution of the engine, the centrifugal force acting on the weight 40 overcomes the tension of the spring 43 and turns the weight 40 about the pivot 41 in the direction of the arrow z into the position which is illustrated in the drawing by dotted lines. The result of this is that the controlling pin 38 is raised by the connecting rod 42 and therefore the lever 35 is transferred into the position illustrated in dotted lines in the drawing. Then the direction in which the force of the spring 33 acts lies above the pivot 30 of the lever 31, 32, so that this lever snaps into its other end position illustrated in dotted lines in the drawing in which it makes contact with the contact 29. The circuit of the electromagnet 25 is thereby closed so that the armature 24 is attracted and the stylus 18 is moved upwardly a corresponding distance on the chart. The line which has hitherto been drawn on the rotating chart by the stylus 18 is therefore broken and there are peaks provided in the curve drawn, as illustrated by way of example at the points 45, 46 and 47. The length of these peaks, measured in the direction of rotation x of the chart, and their position relatively to the time scale on the chart give accurate information as to when the permissible maximum speed of revolution was exceeded and for how long. It is also possible to determine from the diagram the vehicle speed at which the engine developed the unpermissible speed of revolution.

When the speed of revolution of the engine again falls below the maximum permissible speed, the centrifugal weight 40 is returned into the starting position illustrated by the action of the spring 43, the consequence of which is that the contact lever 31, 32 again opens the circuit 26, 27 of the electromagnet 25. The stylus 18 together with its lever 20 is then likewise returned into the starting position by the action of the spring 22.

Instead of the centrifugal weight 40, another device of any suitable construction which responds to variations in speed of revolution may be employed for controlling the contact lever 31, 32 which is connected in the circuit of the electromagnet. Thus, for example, an astatic centrifugal pendulum of the construction shown in Figures 2 and 3 can be employed. An astatic centrifugal pendulum of this kind has the property that, when a predetermined speed is reached, it is deflected suddenly out of its normal position into an operative position. The contact device 29—34, shown in Figure 1, which operates with a snapping action is then not necessary, but instead of this the following construction may be adopted.

On the shaft 39, which is connected to the part of the machine to be watched, is mounted a disc 48 which carries the pendulum masses 50 and 51 which can turn about the pivots 49. The two pendulum masses are ordinarily drawn by return springs 52 and 53 against stops 54 and 55 respectively. When a definite predetermined speed of revolution is reached, the pendulum masses 50 and 51 move suddenly out of their normal position illustrated in Figure 3 into their operative position, their movement being limited by the stops 56 and 57. The contacts 58, 59 on the one hand and the contacts 60 and 61 on the other hand are thereby closed. A conductor 62 leads from the contact 59 to a slip ring 63 and a conductor 64 leads from the contact 61 to a slip ring 65. The two slip rings 63 and 65 are carried by the shaft 39 and rotate with it. Brushes 66 and 67 make contact with the slip rings 63 and 65.

In the circuit which is controlled by the pendulum mass 51 is connected a lamp 68 which is illustrated as a preliminary signal. When the pendulum masses are deflected the circuit in which the magnet 25 of Figure 1 is connected is closed.

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PUBLISHED

MAY 25, 1943.

BY A. P. C.

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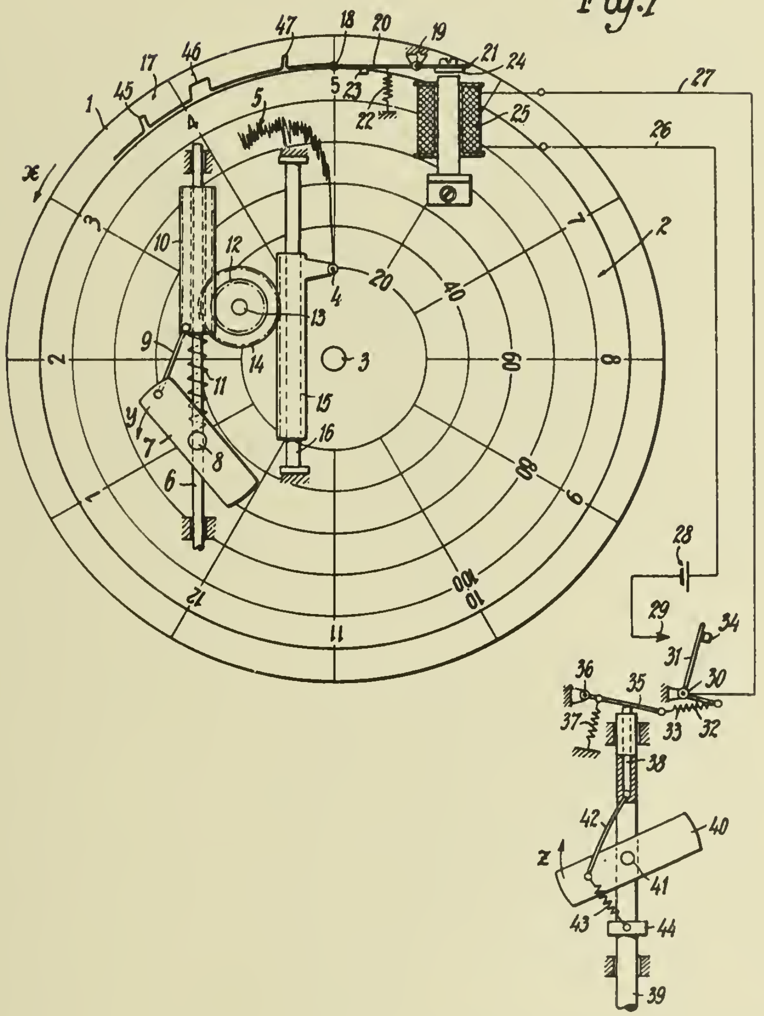
INSTRUMENTS FOR SUPERVISING THE RUNNING OF POWER DRIVEN VEHICLES

Filed Feb. 21, 1939

Serial No. 257,685

2 Sheets-Sheet 1

Fig. 1



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INSTRUMENTS FOR SUPERVISING THE RUNNING OF POWER DRIVEN VEHICLES
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Serial No. 257,685
2 Sheets-Sheet 2

Fig. 2

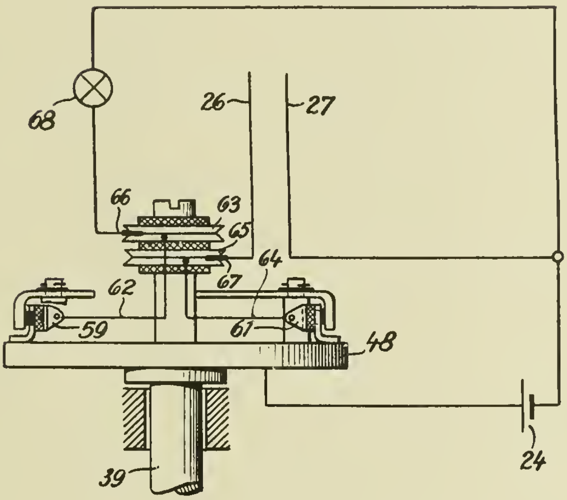
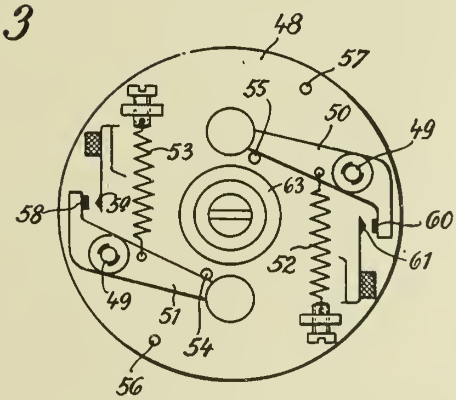


Fig. 3



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Serial No. 259,030

ALIEN PROPERTY CUSTODIAN

COMPLEMENTARY TOTALISER

Hugo Ernst Kämmel, Zella-Mehlis, Germany; vested in the Alien Property Custodian

Application filed February 28, 1939

This invention relates to a complementary totalizer, especially for typewriting-calculating machines equipped with total taking means and with mechanism for controlling the "fugitive 1."

Machines of this kind have already become known in which, however, the "fugitive 1" was introduced manually. Later, the introduction of the "fugitive 1" was performed automatically in dependence on the carriage movement, but these machines had the drawback that the proper total taking of the amounts could not be checked by a clear sign testing or printing device.

These drawbacks are eliminated according to the invention by the mechanism for controlling the "fugitive 1" being arranged to be automatically reversed in dependence on the position of the numeral wheels at the highest calculating place in the direction of the carriage steps, if a value in positive form is present in the set of negative numeral wheels after the complementary totalizer has left its active position, and, if a value in positive form is present in the set of positive numeral wheels before the complementary totalizer arrives in its active position, in such manner that the "fugitive 1" is transferred to the set of positive numeral wheels in additive sense.

In the accompanying drawings, several constructions of the subject matter of the present invention are illustrated by way of example, as follows:

Figs. 1 to 13 illustrate the first construction.

Fig. 1 is a perspective illustration showing a typewriting-calculating machine viewed from the left and the front, the calculating mechanism of the machine being concealed in a casing, the complementary totalizer being shown in full lines and a normal, a minus, and an idle column totalizer being shown in dot-and-dash lines.

Figs. 2 and 3 are elevations of the complementary totalizer, viewed from the right, that is, in the direction of the arrow in Fig. 1, and showing the mechanism for controlling the "fugitive 1" in its initial and reversed position, respectively.

Fig. 4 is a detail.

Fig. 5 is a perspective illustration of the complementary totalizer, viewed from the right and the front of the machine.

Fig. 6 shows part of a locking wheel lever in the complementary totalizer.

Figs. 7 and 8 are elevations of the complementary totalizer, viewed from the right in Fig. 1 and partly broken away, showing one of its locking and setting levers in its active and inactive position, respectively.

Figs. 9 and 11 are elevations of the complementary totalizer, viewed from the left in Fig. 1 and showing the mechanism which operates a pair of screens for alternately concealing the positive and the negative set of numeral wheels in the complementary totalizer, in the initial position in which a "minus" value is calculated, and in the position in which the "minus" value is replaced by a "plus" value, respectively.

Fig. 10 shows diagrammatically the two sets of numeral wheels in the complementary totalizer, and a train of gears connected thereto.

Fig. 12 is a front elevation of the complementary totalizer.

Fig. 13 is a front elevation of the place indicator.

Fig. 14 is an elevation, viewed as in Figs. 7 and 8, of a second construction in which the mechanism controlling the "fugitive 1" is modified.

Fig. 15 shows part of a form to be filled in by the typewriting-calculating machine.

Figs. 16 to 20 are diagrams showing various relative positions of an abutment plate forming part of the screen-operating mechanism at the left of the complementary totalizer, Figs. 9 and 11, and of lugs on the place indicator.

Figs. 21 to 26 show the positions of the complementary and column totalizers for performing the calculating operations required for filling in the form, Fig. 15.

Figs. 27 to 30 illustrate the third construction of the complementary totalizer.

Figs. 27, 28, and 29 correspond to Figs. 2, 3 and 5.

Fig. 30 is a detail.

Figs. 31 to 34 illustrate the fourth construction which is distinguished by a modified tensioning member.

Figs. 31 and 33 are front elevations of the complementary totalizer in its initial position and in its active position with respect to the tensioning member, respectively.

Fig. 32 is a vertical section of the frame of the machine, viewed from the left in Figs. 31 and 33.

Fig. 34 is a perspective illustration of the parts shown in Figs. 31 to 33.

Figs. 35 to 38 illustrate the fifth construction of the complementary totalizer.

Figs. 35 and 38 are elevations corresponding to Figs. 9 and 11.

Fig. 36 is a front elevation of the complementary totalizer, partly broken away at the right.

Fig. 37 is a perspective illustration of the com-

plementary totalizer, with its side plates taken apart.

Figs. 39 and 40 which illustrate the sixth construction, are elevations corresponding to Figs. 9 and 11.

Figs. 41, 42, and 43 illustrate the seventh construction.

Figs. 41 and 42 are elevations corresponding to Figs. 9 and 11.

Fig. 43 is a detail.

Fig. 44 is a diagram illustrating a calculating example illustrating the object for which the fifth, sixth, and seventh construction were designed.

Fig. 45 is an elevation of a device for indicating the overstepping of the capactiy of the complementary totalizer.

General description

Before the subject matter of the invention propèr will be described, it should be noted for a better understanding of the invention, that the entries made in the form F (Fig. 15) may be performed, by way of example, in a typewriting-calculating machine with automatic total taking mechanism, but obviously the complementary totalizer is not limited to typewriting-calculating machines with automatic total taking mechanism, and may be adapted to any other typewriting-calculating, or calculating machine.

A totalizer suspension rail **1** which is attached to the paper carriage, not shown, supports three column totalizers I, II and III, shown in dotted lines and a complementary totalizer **2** shown in full lines at the right of the column totalizers. I is a normal column totalizer, II is a minus column totalizer in which the sequence of the numeral on its numeral wheels is reversed, and III is an idle column totalizer.

The column totalizers I and II are opposite the columns A and B, respectively, of the form F (Fig. 15) and the idle totalizer III is opposite the column C.

Arranged opposite the column D of the form F is the complementary totalizer **2**. This totalizer is equipped with a lower positive set **115** (Fig. 12) of numeral wheels and an upper negative set **116** of numeral wheels which are displayed through slots in the front plate of the complementary totalizer. A screen **113** is provided for concealing the positive set **115**, and a similar screen **112** is arranged for the negative set **116**. The screens are attached to the free ends of a pair of arms on a four-armed screen controlling lever **102** (Figs. 1, 9, 11 and 12) which is fulcrumed at the left-hand side plate **39** of the complementary totalizer **2**. In the normal position of the lever **102** the screen **113** conceals the positive set **115**, and the screen **112** exposes the negative set **116**. The lower end of the front plate **200** of each totalizer is provided with a horizontal rib **199** which, cooperating with a roller **198**, Figs. 1, 31 to 34, at the upper end of a retaining plate **194**, prevents rising of the totalizers.

The arrangement of the mechanism for controlling the "fugitive 1" at the right-hand side plate of the complementary totalizer

The complementary totalizer **2** has a side plate **3** at the right (Figs. 2 and 5) and a side plate **39** at the left, as described. A controlling plate St (Figs. 2 and 3) for determining the kind of calculation, and an unlocking plate E, with a recess **E1**, are arranged between the side plates of the complementary totalizer **2**.

A pulling lever **5** (Figs. 2, 3 and 5) is mounted to swing about a bearing screw **4** in the side plate **3**, and a roof-shaped cam **74** is provided at its tail end **73**. In the normal position of the pulling lever **5**, Fig. 2, a lug **6** which extends to the left at right angles from the pulling lever **5**, bears on the cover plate **7** of the complementary totalizer **2** and thereby limits the swinging movement of the lever **5** in anti-clockwise direction. A pulling rod **9** is pivoted to the front end of the pulling lever **5** with its upper end by a headed screw **8**. At its lower end, the pulling rod **9** has an elongated hole **10** through which extends a headed screw **11**. This headed screw is inserted in the front arm **14** of a sector lever **15** which is mounted to swing on a bearing screw **16** in the side plate **3**. Further, the headed screw **11** engages in a slot **12** in the rear end of a reversing lever **13** which is mounted to swing about the right-hand end of a shaft **38** whose left-hand end is threaded and engages in a hole in the left-hand side plate **39**, (Figs. 5, 9 and 11), it will appear that in this manner the reversing lever **13** and the sector lever **15** are swung when the pulling rod **9** is shifted.

Teeth **17** at the rear end of the sector lever **15** mesh with a pinion **18**. This pinion which extends through an elliptical hole **20** in the right-hand side plate **3** of the complementary totalizer **2**, is rigidly connected to a locking wheel **19**. The pinion **18** and the locking wheel **19** are mounted together on a pin **22** (Fig. 6) which is secured to the locking-wheel lever **23** allotted to the lowest calculating place of the complementary totalizer **2**, and are held by a nut **24**. The pinion **18** meshes with a driving spur gear **21** (Fig. 6) at the lowest calculating place of the complementary totalizer **2**. When the lowest calculating place of the complementary totalizer **2** moves into active position and the locking wheel lever **23** is swung in the direction of the arrow **25** (Fig. 6), one of the gaps **26** in the locking wheel **19** engages over a fixing rod **27** which projects from the right-hand side plate **3**, to prevent rotation of the pinion **18** and the locking wheel **19** during the operation of the lowest calculating place.

At the crooked front end **28** of the arm **14** of the sector lever **15**, a roller **30** is mounted to rotate a rivet **29** for cooperation with notches **31** and **32** in a spring catch **33**. The spring catch **33** is mounted to swing about a bearing screw **34** in the side plate **2** of the complementary totalizer **2** and is permanently turned anti-clockwise by a spring **35** (Figs. 2, 3, and 5) whose front end is secured to a pin **36** riveted into the catch **33** and whose rear end is anchored on a bearing member **37** (Figs. 2 and 3) secured in the side plate **3**, so that one of the notches **31** or **32** in the spring catch **33** engages the roller **30** on the sector lever **15** holding the sector lever **15**, and, through, the headed screw **11**, also the pulling rod **9** and the reversing lever **13** in their positions.

The reversing lever **13**, is mounted to swing on the threaded shaft **38** which extends through a hole in the right-hand side plate **3** and is screwed into the left-hand side plate **39** of the complementary totalizer **2**. Mounted to swing on the threaded shaft **38** between the side plates **3** and **39** is a general reversing flap **40** whose extension **41** (Fig. 5) projects beyond the side plate **3** at the right and is engaged by a forked part **42** of the reversing lever **13** so that it is held in the posi-

tion to which it has been swung in this manner and in conformity with the position of the lever 13. When the reversing flap 40 is in its vertical position (Fig. 2) it effects the reversal of the kind of operation of the typewriting calculating machine, setting the machine to subtraction so that when total taking the value calculated in the complementary totalizer 2, italics are printed. In the rocked position (Fig. 3) of the reversing flap 40, it is in inactive position.

An arm 43 projects forwardly from the reversing lever 13 and on this arm t a roller 44 is mounted to rotate which upon the carriage return cooperates with a cam 45 (Figs. 1, 5 and 12) of a tensioning member 46. An incline 49a is arranged at the rear of the cam 45. The tensioning member 46 which is crooked as best seen in Fig. 3, is secured to the right-hand end of the front wall 48 of the calculating casing by screws 47 and its upper end 49 projects through a slot 50 (Fig. 1) in the top plate of the calculating casing 51.

The pulling rod 9 is equipped with a wedge 52 (Figs. 5, 7 and 8) whose inclined edge 53 is arranged for cooperation with the inclined end 54 of a pawl 55. This pawl is secured on the right-hand journal 56 of a locking flap 57, Figs. 7 and 8. When the pulling rod 9 is shifted upwards the inclined edge 53 of its wedge 52 slides along the inclined end 54 of the pawl 55, turning the pawl end the locking flap 57 anti-clockwise (Fig. 8). The locking pawl 57 engages below the front ends of locking and setting arms 59 arranged at the comma places, whereby a locking tooth 58 (Figs. 7 and 8) on each lever 59 is moved clear of the teeth of the corresponding drive wheel 60. The driving wheels are now released during the reversal of the control members described in the section entitled "The operation of the complementary totalizer and the mechanism parts cooperating with it", for introducing the "fugitive 1" into the lowest calculating place.

Springs 59a, Fig. 7, at the locking and setting levers 59 tend to turn the locking flap 57, and with it the pawl 55, permanently clockwise, the inclined end 54 of the pawl acting on the upper incline 53 of the wedge 52 and moving the pulling rod 9 in such manner that the upper edge 10a of its elongated hole 10 bears upon the shank of the screw 11 (Fig. 7). This has for its consequence that the pulling rod 9 can be raised for the distance limited by the elongated hole during the raising of the locking and setting levers 59 (Fig. 8), before the pulling rod 9 can act on the reversing lever 13 and the sector lever 15.

Mounted to swing on the bearing member 37 (Figs. 2 and 3) at the right-hand side plate 3 of the complementary totalizer 2 is a carriage-return releasing bellcrank 62 with a handle 63 at its front end. The rear end of the bellcrank 62 is guided by means of a screw 61 extending through an elongated hole 62a in the bellcrank. Spacing sleeves, not shown, hold the bellcrank at the proper distance from the side plate 3. The bellcrank is arranged for releasing the automatic carriage return of the typewriting-calculating machine, the bellcrank 62 being turned anti-clockwise about the bearing member 37 until a pin 64 at the free end of a flat spring 65 which is riveted to the bellcrank, engages in a depression 66. At the same time a lug 67 at the rear end of the bellcrank 62 acts on not illustrated parts which have been shown in the patent 2.046.524 the end of the movement of the carriage to the left, effecting the carriage return.

A check 68 (Figs. 2, 3 and 5) is secured to the right-hand side plate 3 of the complementary totalizer 2, for preventing release of the calculating mechanism of the typewriting-calculating machine while the controlling members of the complementary totalizer 2 are reversed.

Two stays 69 and 70 (Fig. 5) are fixed on the right-hand side plate 3 of the complementary totalizer 2 to which is attached by screws 72 (Fig. 12) a casing 71 (Figs. 1 and 12) adapted to the shape of the side plate 3.

As mentioned, a roof or inverted V member 74 is arranged at the tail end 73 of the pulling lever 5 (Fig. 5).

The controlling parts at the place indicator of the typewriting-calculating machine for reversing the controlling members of the complementary totalizer

A holder 76 for a place indicator 77 (Figs. 1, 2, 3 and 13) is secured to the front carriage rail 75 (Fig. 1) and its pointer 78 indicates that calculating place of a column totalizer which is in calculating position at the time. A plate 79 extends to the right from the place indicator 77 and a hinge member 80 is held on the plate 79 by screws 81. Eyes 82 (Fig. 5) of the hinge member 80 support a bearing shaft 83 on which a controlling flap 84 for the pulling lever 5 is mounted to swing. By a torsion spring 85 (Figs. 1, 5 and 13) which is wound about the bearing shaft 83, the controlling flap 84 is turned permanently anti-clockwise (Fig. 2) until an abutment 86 (Fig. 1) which is arranged the flap 84, engages the hinge member 80 and holds the flap 84 in its normal, that is, vertical, position. In this position of the flap 84, an inclined edge 87 (Figs. 1 and 13) at the lower end of a right-hand extension 88 of the flap 84 can cooperate with the roof-shaped cam 74 on the pulling lever 5. A lug 90 extends at right angles and in forward direction from a left-hand extension 89 (Figs. 1, 2, 3, 5 and 13) of the flap 84. The front edge 91 (Fig. 1) of the lug can cooperate with a trapeze-shaped plate 124 at the rear end of the four-armed lever 102 (Figs. 1, 9 and 11) which is at the left-hand side plate 39 of the complementary totalizer 2.

A controlling lug 92 Figs. 2 to 4 and 13 is secured to the lower side of the place indicator 77 by screws 93. A projection 94 extending downwards from this lug 92 has an incline 95 (Fig. 13) projecting into the plane of the extension 88 on the flap 84 and can act in the same manner on the roof shaped cam 74 on the pulling lever 5 at the complementary totalizer. However, this projection 94 will act on the cam 74 of the pulling lever 5 only if the flap 84 has been swung so far to the rear that its extension 88 is beyond the path of the cam 74 (Fig. 4), as will be fully described in the section entitled "The operation of the complementary totalizer and the parts of the mechanism cooperating with it" The arrangement of the extension 88 and the projection 94 has in the present instance been advantageously so determined that in the normal position (Fig. 2) of the flap 84 its inclined edge 87 acts on the cam 74 for two carriage steps earlier than the highest calculating place of the complementary totalizer 2 moves into active position while the incline 95 of the lug 92 can act on the cam 74 only upon the second feeding step of the paper carriage of the typewriting-calculating machine, after the lowest place of the complementary totalizer 2 has calculated.

The arrangement of the screen-controlling mechanism at the complementary totalizer

At the driving wheel 96 (Figs. 1, 9 and 11) which is allotted to the highest calculating place in the complementary totalizer 2 a cam 97 is secured which slides in an arcuate slot 98 in the left-hand side plate 39 of the complementary totalizer 2. The thicker head 99 (Figs. 9 and 11) of the cam projects beyond the side plate 39. This head 99 of the cam 97 can act on an arcuate edge 100 at one arm 101 of the four-armed lever 102. The four-armed lever 102 is mounted to swing at the side plate 39 of the complementary totalizer 2 about a bearing screw 103. A power accumulator, here shown as a spring 104 which is clamped to the side plate 39 by a headed screw 105 (Figs. 9 and 11) and whose downwardly projecting spring arm 106 engages in a recess 107 of the arm 101, tends to turn the four-armed lever 102 permanently clockwise about the screw 103, forcing the arcuate edge 100 of the arm 101 of the lever 102 against the head 99 of the cam 97, (Fig. 9).

Two arms 108 and 109 project forwardly from the four-armed lever 102 to which the screens 112 and 113 (Figs. 9 to 12) are secured by screws 110 and 111, respectively. The screens are connected by a strip 114 (Fig. 2) to constitute a frame as described, when the four-armed lever 102 is in its normal position according to Fig. 9, the screen 113 conceals the positive set of numeral wheels 115 in the complementary totalizer 2 (Fig. 12) while the screen 112 exposes the negative set of numeral wheels 116 of the totalizer 2. It should be noted that in this case the "fugitive 1" is already introduced into the lowest calculating place by cooperation of the roller 44 (Figs. 2, 3 and 5) on the reversing lever 13 and the tensioning member 45, as will be described in the section entitled: "The operation of the complementary totalizer and the parts of the mechanisms cooperating with it," whereby all numeral wheels of the negative set 116 are moved to "zero" (Fig. 1).

When the negative numeral wheels 116 (Fig. 12) of the column totalizer 2 after reversing by the lever 13 show "zero" (Fig. 10), the concealed positive numeral wheels 115 show "9". If in this case a value, for instance, 0.80, is introduced positively into the complementary totalizer 2, the exposed negative numeral wheels 116 indicate the value "9 999 999.20", while the concealed positive numeral wheels 115 indicate the value "0 000 000.79". Since during the introduction a tenth transfer as far as the highest place has occurred, the driving wheel 96 is rotated in the direction of the arrow 117 (Fig. 9 and 11). The head 99 of the cam 97 on the driving wheel 96 now moves from the position in Fig. 9 into the position in Fig. 11, releasing the edge 100 of the arm 101 on the four-armed lever 102. The lever is now free to swing clockwise under the action of the spring 104 until the lower edge 118 of the screen 113, which engages in a slot 119 in the left-hand side plate 39 of the complementary totalizer 2, and in a slot 120 in its right-hand side plate 3 (Figs. 11 and 3) abuts against the respective lower ends 121 and 122 of the slots 119 and 120. The screen 112 now conceals the negative set of numeral wheels 116 in the complementary totalizer 2, while the screen 113 exposes the positive set of numeral wheels 115.

A rearwardly extending arm 123 is arranged on the four-armed lever 102 which is crooked to the right at right angles and made into a trapeze-shaped plate 124 (Fig. 1), the inclined edge 125 at the left of the plate 124 projecting into the path of the lug 90 (Figs. 1, 2, 3 and 5) at the flap 84 in the normal position of the four-armed lever 102, as shown in Fig. 9. In the position of the lever 102 according to Fig. 11, the plate 124 has been swung so as to place its inclined edge 125 above the path of the lug 90 of the flap 84, sliding past the lug and not influencing it.

The operation of the complementary totalizer and the parts of the mechanism cooperating with it

In the following, the operation of the complementary totalizer 2 and its controlling members according to the invention, in cooperation with the controlling parts of the place indicator 77 and the tensioning member 46 (Fig. 1), will be described for the accounting entries in the form F (Fig. 15).

It is assumed that all members of the complementary totalizer 2 and all parts of the place indicator 77 occupy their normal positions, as shown in Figs. 1, 5 and 9. In the normal position of the members of the complementary totalizer 2 as shown in Figs. 5 and 9, the "fugitive 1" has already been added to the lowest calculating place of the negative set of numeral wheels 116 in the complementary totalizer 2. The consequence was that the train of gears of this calculating place was turned from "9" to "0" and due to the tens transfer which occurs during this and is transmitted from one calculating place to the next higher calculating place of the complementary totalizer 2, all numeral wheels of the negative set of numeral wheels 116 have been turned to "zero". During this rotation of the driving wheel 96 (Fig. 9) at the highest calculating place of the complementary totalizer 2 against the direction of the arrow 117, the head 99 of its cam 97 has acted on the edge 100 of the arm 101 and turned the four-armed lever 102 anti-clockwise against the action of the spring 104, so that the screen 112 exposes the negative set of numeral wheels 116 (Fig. 12) while the screen 113 conceals the positive set of numeral wheels 115 which has now been turned to "9". The trapeze plate 124 of the four-armed lever 102 (Figs. 1 and 9) is moved into the path of the lug 90 on the flap 84 of the place indicator 77.

The first operation is that of entering a "credit" amount, for instance, RM. 135,25, in the column B of the form F, as shown in Fig. 15, and of calculating this value in the minus column totalizer II (Fig. 1) and in the complementary totalizer 2. As mentioned, the sequence of the numerals on the numeral wheels in the minus column totalizer II is the reverse of the normal sequence. The minus totalizer II is equipped with a controlling plate St (Figs. 2, 3, 9, 11 and 21) by which the kind of operation of the machine is set for subtraction, and the main driving wheels A1, A3 and A4 (Fig. 21) are driven in the direction of the arrow in wheel A1 (Fig. 9). By a clutch-controlling plate V (Fig. 21) which is also arranged at the minus column totalizer II, a clutch K is operated to connect the main driving wheel A3 to the drive of the machine. As also mentioned, the unlocking plate E (Figs. 9 and 11) of the complementary totalizer 2 which normally unlocks the calculating mechanism of the typewriting-calculating machine in the frame 51, is recessed at E1. This recess is provided for preventing uncoupling of the main driving wheel A4 from the drive by the unlocking plate E when the complementary totalizer 2 moves into active position with respect to the main driving wheel A4.

By depressing the corresponding tabulator key, not shown, the hundreds calculating place in the minus column totalizer II is moved into calculating position, whereupon by depressing the calculating key in the calculating keyboard, not shown, of the typewriting calculating machine, which corresponds to the value "1", the number "1" is typed in the column B of the form F, and entered in negative sense into the hundreds calculating place of the minus column totalizer II. The numeral wheels at the hundreds calculating place now displays "1". At the same time, a "1" is entered into the complementary totalizer 2 in negative sense and the hundreds calculating place of the negative set of numeral wheels 116 in the complementary totalizer displays "1". After the carriage has moved on for one step, a "3", and, as the carriage moves further, the other numbers of the "credit" amount 136,25 are typed similarly in the column B of the form F and calculated in the minus column totalizer II and in the complementary totalizer 2, so that the minus totalizer II and the negative numeral wheels 116 of the complementary totalizer 2 indicate the value "135,25" (Fig. 21).

Now, an "Old Balance" of RM 20.10, which was taken over as a plus value an earlier form, is to be typed in the column C of the form F and to be calculated in the complementary totalizer 2. As the idle column totalizer III is without the clutch-controlling plate V, Fig. 21, the clutch K remains in its normal position in which the driving wheels A1 and A2 (Fig. 22) are coupled to the drive. Nor has the idle column totalizer III a controlling plate S*t*, for controlling the kind of operation so that amounts entered by depression of keys are so in additive sense.

When the idle column totalizer III has been tabulated into active position with its tens place, the value "20.10" is typed in the column C and at the same time is entered in positive sense into the corresponding calculating places in the complementary totalizer 2 so that the value "115.15" (Fig. 22) is indicated at the close of the calculating operations by the exposed negative set or numeral wheels 116 of the complementary totalizer 2. The complementary totalizer 2 has now moved to the left so far that the inclined side 125 (Fig. 1) of the trapeze plate 124 of the four-armed lever 102 is at the right of the lug 90 on the pulling-lever controlling flap 84 (Fig. 16).

The value "115.15" which has been entered in the complementary totalizer 2 is now to be registered as new balance in the column D of the form F by total taking. For this purpose, the complementary totalizer 2 is moved into active position with respect to the main driving wheel A1 (Fig. 23) of the calculating mechanism in the frame 51 of the typewriting-calculating machine with its hundreds calculating place by depression of the corresponding tabulator key. During the carriage movement which has been started by the tabulating operation, and two steps before the complementary totalizer 2 arrives in the active position with its highest calculating place, the inclined side 125 of the trapeze plate 124 at the fourarmed lever 102 engages the front edge 91 of the lug 90 at the pulling lever controlling flap 84 (Fig. 17) and swings the flap anti-clockwise against the torsion spring 85, as shown in Fig. 4, about the bearing shaft 83, and the extension 88 at the right of the flap 84 moves beyond reach of the roof-shaped cam 74 of the pulling lever 5 (Figs. 4 and 14). During the following moving on of the paper carriage to the left, the rear edge 124*a* (Fig. 1) of the trapeze plate 124 holds the flap 84 in its swung-out position until the roof-shaped cam 74 of the pulling lever 5 has moved past the extension 88 of the flap 84. When the edge 124*a* of the trapeze plate 124 releases the lug 90 of the flap 84, the flap swings back into its normal position, as shown in Fig. 2, under the action of the torsion spring 85, in which the abutment 86 of the flap 84 bears on the hinge member 80. Since, the complementary totalizer 2 has a controlling plate S*t* for controlling the kind of operation (Fig. 23), the kind of the calculating mechanism concealed by the frame 51 is reversed to subtraction when the plate S*t* moves into active position. Due to the general reversing flap 40 (Figs. 2 and 5) of the complementary totalizer 2 being held in its vertical or normal position by the reversing lever 13, this flap reverses to addition the calculating mechanism of the typewriting-calculating machine—which had been set to subtraction by the controlling plate S*t* of the complementary totalizer 2—by operating the general reversing key G for reversing the kind of operation (Fig. 1) because the "minus" value 115.15 indicated by the negative set of numeral wheels 116 in the complementary totalizer 2 can be withdrawn from the complementary totalizer only by addition. When the general reversing key G for reversing the kind of operation of the typewriting calculating machine is operated, the value "115.50" is typed in italics upon total taking, characterizing it as a negative balance.

The calculating mechanism concealed by the frame 51 is uncoupled by the unlocking plate E of the complementary totalizer 2.

After the hundreds calculating place of the complementary totalizer 2 has been moved into calculating position, the value "115.50" is withdrawn from the complementary totalizer 2 and typed in column D of the form F (Fig. 15) and the automatic total taking effected thereby.

After the last number "5" of the value "115.50" has been withdrawn from the negative set of numeral wheels 116 in the complementary totalizer 2, and typed in the column D of the form F, the negative numeral wheels 116 again show "zero" and the value "135.25" appears in the minus column totalizer II (Fig. 23). In consequence of the typing of the last number "5" of the value "135.25" a step of the carriage is released and when this step has been performed, the lefthand incline of the roof-shaped cam 74 on the pulling lever 5 (Fig. 1) is at the right-hand side of the projection 94 on the controlling lug 92. (Figs. 1, 13, and 18). Now the paper carriage of the typewriting-calculating machine is brought one step further to the left. At the same time, the left-hand incline of the roof-shaped cam 74 on the pulling lever 5 slides along the incline 95 of the fixed controlling lug 92, and the pulling lever 5 (Figs. 3 and 5) is swung clockwise about its bearing screw 4. The screw 8 now raises the pulling rod 9 and the locking and setting levers 59 (Fig. 7 and 8) are raised by means of the incline 53 of the wedge 52, the incline 54 of the pawl 55, and the locking flap 57, as shown in Fig. 8, unlocking the driving wheels 60 of the complementary totalizer 2. As the pulling rod 9 rises further, the lower end of its elongated hole 10 acts on the screw 11 in the front arm 14 of the sector lever 15 and turns the sector lever 15 clockwise about its bearing screw 16. The roller 30 arranged at the crooked front end 28 of the sector lever 15 leaves the notch 31 in

the spring catch **33** to which the spring **35** is connected, and is engaged by the notch **32**, holding the sector lever **15** in this position (Fig. 3). The swinging movement of the sector lever **15** is transmitted to the reversing lever **13** by the screw **11** and the slot **12**. The reversing lever **13** is swung anti-clockwise about the shaft **38** and, with its forked part **42**, swings the general reversing flap **40** for reversing the kind of operation into the position shown in Fig. 3.

When the sector lever **15** swings clockwise, its teeth **17** turn the pinion **18** and the locking wheel **19** anti-clockwise for one unit, and the pinion **18** (Fig. 6) turns the driving wheel **21** of the lowest calculating place in the complementary totalizer **2**, with which it meshes, clockwise for one unit. In consequence, the "fugitive 1" is added to the lowest calculating place of the complementary totalizer **2**, so that the numeral wheel of the said calculating place in the positive set of numeral wheels **115**, which was at "9," is now turned from "9" *to* "O." In consequence of the positive tens transfer all numeral wheels of the positive numeral wheel set **115** are progressively turned from "9" to "0." When the driving wheel **96** which is allotted to the highest calculating place of the complementary totalizer **2** (Fig. 9) is rotated in the direction of the arrow **117**, the head **99** of its cam **97** releases the arcuate edge **100** of the arm **101** and the four-armed lever **102** is now swung clockwise and into the position shown in Fig. 11 under the action of the power accumulator, or spring, **104**. In this position, the lower edge **118** of the lower screen **113** is seated on the lower ends **121** and **122** of the respective slots **119** and **120** in the side plates **3** and **39** of the complementary totalizer **2**. The screen **113** thus exposes the positive set of numeral wheels **115** in the complementary totalizer **2**, and the screen **112** conceals the set of negative numeral wheels **116**.

This reversing of the controlling members and the introduction of the "fugitive 1" achieved thereby are necessary for printing the clear sign asterisk at the end of each total taking from the complementary totalizer **2**. This is effected by depression of a key, not shown.

The arrows shown in full lines in Fig. 10 indicate the direction of rotation of the several wheels for additive calculation and the arrows shown in dotted lines indicate the direction of rotation for subtractive calculation.

When the clear sign has been printed in the column D of the form F, the lug **67** at the bell-crank **62** (Fig. 3) which has previously been manually moved into its active position, releases the automatic carriage-return device of the machine upon the subsequent step of the paper carriage as described in the patent 2,046,524 for the right hand marginal stop R*a*.

When the paper carriage of the typewriting-calculating machine is moved to the right, the roller **44** at the front end of the reversing lever **13** (Fig. 3) ascends the inclined edge of the cam **45** of the tensioning member **46** (Figs. 1 and 12) whereby the reversing lever **13** is returned into its normal position, as shown in Figs. 2 and 5. Due to the connection of the reversing lever **13**, the sector lever **15**, and the pulling rod **9** by the screw **11**, this rod is pulled down. The incline **52*a*** (Fig. 3) of the wedge **52** acts on the upper edge **55*a*** of the pawl **55**, swinging the pawl anti-clockwise and moving the locking levers **59** into inactive position through the locking flap **57** (Fig. 8).

When the reversing lever **13** (Fig. 3) is swung back, it swings back the sector lever **15** anti-clockwise about its bearing screw **16** through the screw **11**. The roller **30** at the front end **28** of the sector lever leaves the notch **32** in the spring catch **33** and enters the notch **31**. The teeth **17** of the sector lever **15**, through pinion **18** (Fig. 6) rotate the driving wheel **21** (Fig. 6) which is allotted to the lowest calculating place of the complementary totalizer **2**, in anti-clockwise direction, whereby in consequence of the tens transfer which is continued from calculating place to calculating place, the negative set of numeral wheels **116** is again turned to zero. Upon rotation of the driving wheel **96** (Fig. 11) which is allotted to the highest calculating place, against the direction of the arrow **117**, the cam **97** on the wheel **96** swings the four-armed lever **102**, through its arm **101**, anti-clockwise and the screens **112** and **113** are so moved that the screen **112** exposes the negative set of numeral wheels **116**. All parts of the complementary totalizer **2** and the controlling members operating them, are again in the normal positions shown in Figs. 5 and 9.

In the next line of the form F, a "debit" amount of RM "525.32" is to be entered. The normal column totalizer I (Figs. 1 and 24) is without a controlling plate S*t* for determining the kind of operation of the calculating mechanism which is concealed by the frame **51**, and therefore the value "525.32" is entered additively into the complementary totalizer **2**. However, the normal column totalizer I has a clutch-controlling plate V (Fig. 24) which so controls the clutch K that the driving wheel A2 which is normally coupled to the drive, is now uncoupled therefrom (Fig. 24). When the first number "5" of the value "525.32" is entered into the complementary totalizer **2**, the screens **112** and **113** are swung, for the following reasons.

When the train of gears at the hundreds calculating place in the complementary totalizer **2** is rotated in additive sence for five units, a tens transfer to the next higher calculating place occurs when the numeral wheel at the hundreds calculating place of the—for the present concealed—positive set of numeral wheels **115** turns from "9" to "0." This tens transfer is continued as far as the highest calculating place of the complementary totalizer **2**. In consequence, the driving wheel **96** (Fig. 9) at the highest calculating place is turned in the direction of the arrow **117** for one unit. The head **99** (Fig. 9) of the cam **97** on the wheel **96** releases the arcuate edge **100** of the arm **101** on the four-armed lever **102**, as shown in Fig. 11. Under the action of the power accumulator or spring **104**, the four-armed lever **102** now swings clockwise, the screen **112** conceals the set of negative wheels **116** (Fig. 11) in the complementary totalizer **2**, and the screen **113** exposing the positive set of wheels **115**. The trapezeshaped plate **124** of the four-armed lever **102** is moved beyond reach of the lug **90** on the pulling-lever controlling flap **84** (Fig. 11). The positive numeral wheel in the set **115** at the hundreds calculating place of the complementary totalizer **2** now shows "4" when the calculating operation has been completed. The "1" that still misses here is added by tens transfer to the "4" at the hundreds calculating place when the second number "2" of the value "525.32" is introduced into the tens calculating place, so that the numeral wheel at the hundreds place shows the correct value "5." The other numbers of the "debit" amount "525.32" are introduced in the same way, so that the positive

set of numeral wheels 115 in the complementary totalizer 2 shows the value "523.32." The missing "1" of the last number is automatically added later.

Obviously the correct value "525.32" is introduced into the column totalizer I whose set of numeral wheels, as mentioned, has the normal sequence of numerals, and the value is typed in the column A of the form F. For entering the new balance in the complementary totalizer 2 it is necessary to depress the general reversing key G which reverses the kind of operation (Fig. 1), for printing the old or negative balance "115.15" in the column C of the form F in italics, since it is a negative item, after the idle totalizer III has been tabulated into its active position, and to transfer the value "115.15" into the complementary totalizer 2 in subtractive sense. Since the idle totalizer III is without the clutch controlling plate V, the clutch K remains in its normal position when the idle totalizer III moves into active position in which the driving wheel A2 partakes in the rotation of the driving wheel A1 (Fig. 25). At the close of these calculating operations, the set of positive numeral wheels 115 in the complementary totalizer 2 will indicate the value "410.16" (Fig. 25). The "1" which misses in the lowest calculating place, is automatically entered as follows.

When the value "115.15" has been entered and typed, and after the carriage step released by the typing down of the "5" in the lowest calculating place, the left-hand inclined face of the roof-shaped cam 74 (Fig. 1) of the pulling lever 5 is at a short distance from the incline 87 of the extension 88 of the pulling-lever controlling flap 84 (Fig. 19) which flap has remained in vertical position because, the trapeze-shaped plate 124 of the four-armed lever 102 has occupied the position shown in Fig. 11, in which it slides along and above the lug 90 of the flap 84.

For typing the new balance "410.16" (Fig. 25) which has been entered in the complementary totalizer 2, the totalizer is tabulated into active position. At the start of the carriage movement to the left, the roof-shaped cam 74 of the pulling lever 5 (Figs. 5 and 13) is engaged by, and descends along, the incline 87 at the extension 88 of the pulling-lever controlling flap 84. The pulling lever 5 (Fig. 9) is swung clockwise about its bearing screw 4, and the pulling rod 9, the reversing lever 13, and the sector lever 15 are thrown over into the positions shown in Fig. 3. Through the teeth 17 of the sector lever 15, the pinion 18, and the driving wheel 21 (Figs. 5 and 6) the "fugitive 1" is added to the lowest calculating place of the positive set of numeral wheels 115 in the complementary totalizer 2 which now indicates the correct value "410.17" (Fig. 20). The four-armed lever 102 is not influenced by this, as a tense transfer which could rotate the wheel 96 at the highest calculating place, does not occur. After the hundreds calculating place of the complementary totalizer 2 has moved into active position, the value "410.17" is withdrawn by total taking from the complementary totalizer 2 and the value is typed in the column D of the form F. It should be noted that since the general reversing flap 40 for controlling the kind of operation is swung into the position shown in Fig. 3 in which the flap is inactive with respect to the control of the kind in the calculating mechanism of the typewriting-calculating machine which is concealed by the frame 51, the value "410.17" is typed in straight figures indicating a "plus" balance, and the noncancealed positive numeral wheels in the set 115 of the complementary totalizer 2 are returned to "zero." (Fig. 26.) By the step of the carriage which is started by the typing of the number "7" in the value "410.17" the complementary totalizer 2 moves into active position with its right-hand platine place. In this position of the complementary totalizer 2, a further step of the carriage is released, the roof-shaped cam 74 of the pulling lever 5 (Fig. 1) sliding below the fixed controlling lug of the place indicator 77 of the typewriting calculating machine. In this position of the complementary totalizer, the clear sign is printed by depression of the clear sign key, not shown, whereupon the automatic carriage return as described in the Patent 2,046,524 for the right hand marginal stop occurs again. During this movement of the paper carriage of the typewriter-calculating machine to the right, the roller 44 of the reversing lever 43 rises on the incline 45 of the cam on the tensioning member 46, and the controlling members of the complementary totalizer 2 are returned into their normal positions (Figs. 5 and 9).

The purpose for which the second incline 49*a* is provided at the tensioning member 46 (Figs. 1 and 5) is as follows.

At the end of the carriage return, that is, in the right hand final position of the paper carriage of the typewriting-calculating machine, it may happen that the operator inadvertently knocks against the roller 44 on the reversing lever 13 and, without knowing it, reverses the controlling members of the complementary totalizer 2 (Fig. 3). This would result in a miscalculation during the operation of the complementary totalizer 2.

During tabulation, that is, during the movement of the paper carriage to the left, the roller 44 of the reversing lever 13 in this case rises on the incline 49*a* of the tensioning member 46 and returns the controlling members of the complementary totalizer 2 into the normal positions according to Fig. 2.

A second construction of the mechanism for rendering inactive the locking and setting levers 59 for the driving wheels 60 of the complementary totalizer 2 is shown in Fig. 14. In this construction, the pulling rod 9 is equipped with a tooth 127 having an inclined edge 126. When the pulling lever 5 is swung clockwise about its bearing screw 4, the ascending pulling rod 9, with the incline 126 of its tooth 127, acts on an incline 128 at the lower side of a hook 129 at the upper end of an arm 130 which is mounted to swing about a bearing screw 131 in the right-hand side plate 3 of the complementary totalizer 2, and swings the arm 130 clockwise about its bearing screw 131. A pin 132 is riveted into the arm 130 and extends to the rear through a corresponding longitudinal slot 133 in the right-hand side plate 3 of the complementary totalizer 2. When the arm 130 is swung clockwise, the pin 132 acts on a short arm 134 at the locking flap 57, the flap is swung anti-clockwise and moves the teeth 58 of the locking and setting levers 59 clear of the wheels 60. In the reversed position of the pulling lever 5 and the pulling rod 9, as shown in Fig. 3, the tooth 127 of the pulling rod 9 has moved beyond the hook 129 of the arm 130, and the springs 59*a* return the locking and setting levers 59, the unlocking flap 57, the arm 130, and its pin 132, into their normal positions as shown in Fig. 14.

When the reversing lever 13, the sector lever 15, the pulling rod 9, and the pulling lever 5 return into their initial positions (Fig. 2) the edge 135 of the tooth 127 on the pulling rod 9 acts on an incline 136 on the arm 130, whereby the arm 130 is again swung clockwise and the driving wheels 60 of the complementary totalizer 2 remain unlocked for the duration of the reversal through the pin 132, the short arm 134 of the unlocking flap 57, and the flap itself.

In this construction of the mechanism for rendering inactive the locking and setting levers 59, the unlocking of the driving wheels 60 of the complementary totalizer 2 are unlocked more rapidly and more reliably on account of the action of the pin 132 on the short arm 134 of the unlocking flap 57.

The arrangement of the controlling members at the complementary totalizer according to the third construction and Figs. 27 to 30

At the right-hand side plate 3 of the complementary totalizer 2—which is substantially similar to the one described with reference to Figs. 1 to 13—a spring catch 150 is mounted to swing about the bearing screw 4 instead of the pulling lever 5 (Figs. 27, 28 and 29) and the bearing screw 4 is inserted in a bearing bracket 155. A spring 151 which at one end is suspended in a hole 152 in the catch 150, and at the other end is anchored on a pin 153 in the right-hand side plate 3, turns the catch 150 permanently anticlockwise, the normal position of the catch being defined by a lug 154 at right angles to the catch 150 bearing against the upper surface of the bearing bracket 155. In this normal position, the front end 156 of the catch 150 engages in a rectangular recess 157 at the upper end of a bellcrank 158, holding the bellcrank against swinging clockwise about its bearing screw 159 which is inserted in the side plate 3 (Fig. 27). A washer 160 (Fig. 29) holds the bellcrank 158 at the required distance from the side plate 3 of the complementary totalizer 2. The forwardly projection end of the bellcrank 158 is a fork 161 engaging a pin 162 in a slide 163. An elongated hole 164 is made in the upper portion of the slide 163 through which extends a pin 165 secured in the side plate 3 of the complementary totalizer 2. By these means, the slide 163 is mounted for vertical reciprocation. A pin 166 at the lower end of the slide 163 engages in the elongated slot 12 at the upper end of the reversing lever 13 and in a hole 167 of a sector lever 168. The falling off of the slide 163 is limited by a head 169 on the pin 162 engaging the left-hand side face of the fork 161 on the bellcrank 158.

The sector lever 168 is mounted to swing about the bearing screw 16 in the side plate 3. Its teeth 17 (Figs. 28 and 29) mesh with the pinion 18 which extends into the complementary totalizer 2 through the elliptical hole 20 in its side plate 3 where it meshes with the driving wheel 21 (Fig. 6) at the lowest calculating place. The pinion 18 and the locking wheel 19 connected thereto are mounted to rotate about the pin 22 and are held by a nut 24. The teeth of the locking wheel 19 cooperates with a locking cam 170 which is connected to the sector lever 168 by screws and pins. A recess in the locking cam permits a rotation of the wheels 18 and 19 for one unit only at a time.

The reversing lever 13 is mounted to swing on the threaded shaft 38 which, extends through a hole in the right-hand side plate 3 of the complementary totalizer 2 and is screwed into its left-hand side plate 39 (Fig. 29). A washer 38*a* holds the reversing lever 13 at the required distance from the side plate 3 of the complementary totalizer 2. The forked part 42 of the reversing lever 13 (Figs. 27, 28 and 29) engages the general reversing flap 40 for controlling the kind of operation of the machine. Secured to the rearwardly projecting arm of the reversing lever 13 by screws 172 is a link 173 which has a hole 174 at its rear end. In this hole is secured the lower end of a power accumulator, here shown as a spring 175, whose upper end is suspended from a pin 176 in the right-hand side plate 3 of the complementary totalizer 2. The pull of the spring 175 normally holds the reversing lever 13, the sector lever 168, the slide 163, and the bellcrank 158 normally in their initial positions, as shown in Figs. 27 and 29, through the elongated slot 12 in the reversing lever 13 and the pin 166 in the slide 163 which engages in the hole 167 in the sector lever 168. This initial or normal position is determined by the recess 157 in the bellcrank 158 engaging the front end 156 of the catch 150. In this position the set of negative numeral wheels 116 in the complementary totalizer 2 indicates "zero" (Fig. 29). The set of positive numeral wheels 116 indicates "9". At the same time, the four-armed lever 102, with the screens 112 and 113, has been so operated that the screen 113 conceals the positive numeral wheels 115 and the screen 112 exposes the negative numeral wheels 116. The operations by which the sets of numeral wheels 115 and 116 are exposed and concealed by the screens 112 and 113, have been fully described in the section entitled "The operation of the complementary totalizer and the parts of the mechanism cooperating with it."

The roller 44 is provided at the front end of the reversing lever 13 which, during the carriage return as well as during the movement of the carriage to the left, cooperates with the inclines 45 and 49*a* (Fig. 29) of the tensioning member 46 which, as described with reference to the first construction is secured to the right hand end of the front wall 48 of the calculating casing by the screws 47.

At its rear end, the catch 150, like the pulling lever 5 of the first construction, is equipped with the roof-shaped cam 74 for cooperation of the controlling parts arranged at the place indicator 77 of the typewriting-calculating machine. These parts have been fully described in the said section entitled "The operation of the complementary totalizer and the parts of the mechanism cooperating with it." So they will not be described again.

At the upper end of the slide 163, a hook 177 is provided for cooperation with a tooth 178 at the upper end of an arm 179 which is mounted to swing on a pin 180 at the side plate 3 of the complementary totalizer 2. A pin 181 secured in the arm 179, projects into the complementary totalizer 2 through an elongated hole 182 in the side plate 3 and cooperates with usual locking flap 57 (Fig. 27). When the slide 163 moves upwards, the arm 179 is slightly swung clockwise and its pin 181 swings the locking flap 57 anti-clockwise. The flap 57 now raises the locking and setting levers 59 which are only partly shown in dotted lines in Fig. 27, moving their teeth 58 clear of the driving wheels 60 (Figs. 7 and 8) of the complementary totalizer 2, so that the wheels can rotate freely when the controlling members are

moved from the positions shown in Fig. 27 into that shown in Fig. 28, and the "fugitive 1" is thereby entered. The same operation occurs when the members move from the position in Fig. 28 into the normal position in Fig. 27, as in this case the hook 177 of the slide 163 can again act on the tooth 178 of the arm 179.

The casing 71 (Fig. 19) is secured to the two stays 69 and 70 (Fig. 29) in the side plate 3 of the complementary totalizer 2. The casing 71 which is adapted to the shape of the side plate 3, conceals the controlling members and the carriage return releasing bellcrank 62 (Figs. 2, 3, and 12) for manual operation.

The operation of the controlling members of the complementary totalizer of the third construction shown in Figs. 27 to 30

In the following, the operation of the controlling members of the complementary totalizer 2 and their cooperation with the controlling parts of the place indicator 77, and with the tensioning member 46 will be described for the entries to be made in the form F, Fig. 15. With reference to Fig. 1 it is assumed that a normal, or plus, column totalizer I is opposite the column A of the form F, that a minus column totalizer II is opposite the column B, an idle column totalizer III is opposite the column C, and the complementary totalizer 2 is opposite the column D, on the totalizer suspension rail 1.

First, let it be assumed that the column totalizers are set to "zero"—and that the controlling members of the complementary totalizer 2 occupy their initial positions, as shown in Figs. 27 and 29. In this position, the negative set of numeral wheels 116—which is at "zero"—is exposed by the screen 112 and the positive set of numeral wheels 115—which is at "9"—is concealed by the screen 113.

The first item to be booked is the "credit" value of RM "135.25". This value is typed in the column B of the form F (Fig. 15) in the manner described in the said section entitled "The operation of the complementary totalizer and the parts of the mechanism connected with it", and is subtractively entered in the minus column totalizer II (Fig. 1) and in the complementary totalizer 2, so that at the close of the operation the numeral wheels of the minus column totalizer II and the negative numeral wheels 116 of the complementary totalizer 2 indicate the value "0 000 0135.25" and the positive numeral wheels 115 which are concealed by the screen 113, are at "9 999 9864.74."

The next operation is that of entering the "old balance" RM "20.10" in the column C of the form F which, at the same time is entered in the complementary totalizer 2 as a positive value. The idle column totalizer III which is opposite the column C of the form F effects only the necessary controls of the typewriting-calculating machine. At the end of this operation, the negative numeral wheels 116 of the complementary totalizer 2 indicate the value "0 000 0115.15" and the concealed positive numeral wheels 115 are at 9 999 9884.84."

During these accounting operations, the controlling members of the complementary totalizer 2 have not been operated. The consequence is that, when the complementary totalizer 2 and the column D of the form F are tabulated into writing position for typing the "new balance" by total taking from the complementary totalizer 2, the edge 125 (Fig. 29) of the trapeze plate 124 at the rear of the four-armed lever 102 which carries the screens 112 and 113 acts on the lug 90 of pulling-lever controlling flap 84 on the place indicator 77 and swings the flap anti-clockwise into the position shown in Fig. 4. The extension 88 of the flap 84 is moved out of the path of the roof-shaped cam 74 at the rear end of the catch 150, so that the cam is not operated. The flap 84 is held in its swung-out position by the rear edge 124a of the trapeze plate 124, until the cam 74 of the catch 150 has moved past the extension 88 of the flap 84 during the tabulating movement. When the edge 124a of the trapeze plate 124 has released the lug 90, the flap 84 returns into its initial position (Figs. 27 and 29) under the action of its torsion spring 85.

The tabulating movement of the paper carriage of the typewriting-calculating machine is completed in the present instance when the hundreds calculating place of the complementary totalizer 2 has moved into active position. By automatic total taking operation the value "115.15" is withdrawn from the complementary totalizer 2 and typed in the column D of the form F. The set of negative numeral wheels 116 in the complementary totalizer 2 shows again "zero" after the typing of the value "115.15" and the concealed positive numeral wheels 115 are again at "9". As mentioned, the value "115.15" is typed in italics, to show that it is a negative balance.

After the completion of every total taking from the complementary totalizer 2 it is desirable to check the correctness of the total taking operation in the machine, for which purpose in the present instance the clearsign asterix (Fig. 15) is printed by depression of a clear sign key, not shown, only when all positive numeral wheels 115 of the complementary totalizer 2 are at "zero". The zero position of the positive numeral wheels 115 is maintained by adding the "fugitive 1" to the last calculating place. For this purpose, the controlling members (Fig. 27) of the complementary totalizer 2 are positively reversed as follows:

After the last number of the value "115.15" has been withdrawn from the set of negative numeral wheels 116 of the complementary totalizer 2, and typed in the column D of the form F (Fig. 15). whereby the carriage step which has been positively started, is completed, the roof-shaped cam 74 of the catch 150 has arrived at the right of the fixed projection 94 of the place indicator 77. This relative position of the cam 74 and the projection 94 is shown in Fig. 19 and described in the said section entitled "The operation of the complementary totalizer and the parts of the mechanism cooperating with it." When the paper carriage now moves to the left for one step more, the roof-shaped cam 74 of the catch 150 slides down along the incline 95 (Fig. 29) of the projection 94 and the catch 150 (Figs. 27 and 29) is turned clockwise against the action of its spring 151, so that its front end 156 releases the recess 157 in the bellcrank 158. Under the action of the power accumulator, or spring 175, the reversing lever 13 swings anti-clockwise about the threaded shaft 38 and, through its elongated slot 12 and the pin 166, raises the slide 163. The hook 177 of the slide 163, through the tooth 178 at the arm 179, the pin 181, and the flap 57 (Fig. 27) disengages the locking and setting levers 59 from the driving wheels 60 (Fig. 14) of the complementary totalizer 2. When the slide 163 ascends, its pin 162 turns the bellcrank 158 clockwise into the position shown in Fig. 28. The swinging movement of the reversing lever 13, through its slot 12, the pin 166, and the hole 167,

turns the sector lever 168 clockwise about the bearing screw 16, and the wheels 18 and 19 are rotated for one unit in anticlockwise direction, the pinion 18 adding the "fugitive 1". Herewith, through positive tens transfer, all positive numeral wheel 115 are progressively turned to "zero". At the same time, the screens 112 and 113 are so operated that the screen 112 conceals the negative set of numeral wheels 116—which is now at "9"—and the screen 113 exposes the "zero" indicating positive set of numeral wheels 115. The reversing movement of the reversing lever 13, the slide 163, the bellcrank 158, and the sector lever 168 is limited by the lower end of the elongated hole 164 in the slide 163 abutting against the pin 165 (Fig. 28). The rotation of the wheels 18 and 19 is, after one unit, arrested by the locking cam 170, that tooth 19*a* (Fig. 28) which is in the corresponding position at the time, bearing against the edge of the cam 170.

After the paper carriage has performed its step and the clear sign has been printed, tabulation and carriage return are effected automatically as described in the Patent 2,046,524.

During the return movement of the paper carriage of the typewriting calculating machine, the complementary totalizer 2 moves into active position with respect to the tensioning member 46 (Fig. 29), the roller 44 of its reversing lever 13 ascending on the incline 45 of the tensioning member 46, whereby the reversing lever 13 is returned into its normal position, as shown in Fig. 27, against the action of the power accumulator, or spring 175. The slide 163 is moved downwards and its hook 177 again operates the members 178, 179, 181, 57 and 59, for releasing the driving wheels 60. At the same time, the bellcrank 158 is swung back into its normal position (Fig. 27) anti-clockwise and the catch 150 is released and is now swung anti-clockwise by its spring 151 until its lug 154 again engages the upper surface of the bearing bracket 155. The front end 156 of the catch 150 again engages in the recess 157 in the bellcrank 158 (Figs. 27 and 29).

When the reversing lever 13 is swung back into its normal position, the sector lever 168 is turned anti-clockwise by the parts 12, 166, and 167, its teeth 17 turning the wheels 18 and 19 for one unit and again entering the "fugitive 1" into the lowest calculating place of the negative set of numeral wheels 116. By the continuous tens transfer, the negative numeral wheels 116, on the one hand, are turned again to "zero" and the positive numeral wheels 115 to "9", and, on the other hand, the screens 112 and 113 are returned into their initial positions according to Figs. 27 and 29.

In the accounting example which has been described by way of example with reference to Fig. 15, there was a negative "new balance" amounting to "115,15". If, with other accounting operations, a positive "new balance" results, the pulling lever controlling flap 84 of the place indicator 77 remains in its normal position according to Fig. 29 when the complementary totalizer 2 moves into its active position by tabulation, due to suitable reversing of the edge 125 of the trapeze plate 124. In consequence, the extension 88 of the flap 84, before the complementary totalizer 2 arrives in its active position, acts on the roof-shaped cam 74 of the catch 150, so that the members 13, 163, 158, and 168 are reversed before the highest calculating place of the complementary totalizer 2 has arrived in its active position.

Providing the catch 150, the bellcrank 158, the slide 163, the sector lever 168, the reversing lever 13, the link 173, and the power accumulator, or spring 175, has the advantage that the projection 94, or the extension 88, of the pulling lever controlling flap 84 of the place indicator 77 have only to throw over the catch 150 against the action of its spring 151—which is weak—without appreciable effort, while the reversal proper of the controlling members is effected by the power accumulator, or spring, 175. As compared with this, in the first and second constructions, Figs. 1 to 13 and Fig. 14, the members are reversed by the projection 94 or the extension 88 of the flap 84 on the place indicator 77. This requires a much greater effort, and the place indicator 77 must be braced for withstanding it. Notwithstanding such extra bracing of the place indicator 77, it may happen that it springs away to the rear, so that the reversal failed or the carriage step was not performed. In the third construction, the place indicator 77 is not braced, and yet a perfectly reliable reversing of the controlling members is obtained.

A roof-shaped member 185 (Fig. 30) is secured on the bearing bracket 155 (Figs. 29 and 30) by screws 155*s*. The roof portion 186 of the member 185 is slotted at 187 for admitting the lug 94 and the extension 88 (Fig. 29) of the flap 84 to the cam 74 of the catch 150. The roof portion 186 of the member 185 is positioned above the cam 74 of the catch 150 for preventing inadvertent reversal of the members of the complementary totalizer 2. For instance, it may happen that when the paper carriage is at the right-hand end of its movement, and the operator inserts a form in the paper carriage, he accidentally depresses the cam 74 so that the catch 150 is thrown out and the controlling members are reversed, resulting in a miscalculation. This is prevented by the roof member 186 which only admits the lug 94 and the extension 88 through its slot 187. If, by any circumstance, for instance, by an unauthorized person attempting to tamper with the machine, the catch 150 is thrown out and the controlling members are reversed, the roller 44 of the reversing lever 13 rises on the incline 49*a* (Fig. 29) of the tensioning member 46 during tabulation, and the members are returned into their normal positions.

The arrangement of the parts of a modified tensioning member for the controlling members of the complementary totalizer, fourth construction, Figs. 31 to 34

The modification of the tensioning member for the controlling members of the column totalizer 2, as illustrated in Figs. 31 to 34, will now be described.

The retaining plate 194 is secured to the inner side of the vertical portion of the casing 51. Three screws 191 extend at right angles to the front of the machine through holes 192 (Fig. 34) in the casing 51 and their rear ends are inserted in threaded holes 193 in the retaining plate 194. A fourth screw 191 (Figs. 31 and 33) extends in parallel relation to the front of the machine through a hole in the side of the casing 51. Its rear end engages in a threaded hole 193 in a flange 201 (Fig. 34) at the right-hand end of the plate 194 and the screw is surrounded by a distance sleeve 192*a* between the flange 201 of the plate 194 and the portion 190*a* of the casing 51 (Figs. 31 and 33). An extension 195 of the plate 194 is inserted in a slot 196 in the casing 51 and is equipped with a pin 197 on which the roller 198 is mounted to rotate. During the carriage return,

the roller 198 rolls on the rib 199 at the front plate 200 of each totalizer and prevents rising thereof. The flange 201 at the right-hand end of the retaining plate 194 extends toward the rear and with its lower end 202 supports a spring-suspension eye 203 in which is inserted the right-hand end of a power accumulator, or spring, 204. The left-hand end of the spring 204 is attached to a bolt 205 in a downwardly extending part 206 of a tensioning member 207. A bearing boss 208 on the tensioning member 207 is mounted to turn on a bearing screw 211 which is inserted in a hole 209 in the casing 51 and with its rear end engages in a threaded hole 210 of the retaining plate 194. The spring 204 tends to turn the tensioning member 207 permanently anti-clockwise, and this movement is limited by the lower end of a slot 212 in the member 207 bearing against a headed screw 213 (Fig. 31) which extends through a hole 214 in the casing 51 and with its rear end engages in a threaded hole 215 in the retaining plate 194. The right-hand end 216 of the tensioning member 207 extends upwardly in oblique direction and is crooked, extending into the path of the roller 44 on the reversing lever 13 at the complementary totalizer 2 (Fig. 32). A tensioning arm 218 (Fig. 31 to 33) is mounted to swing about a bearing screw 217 at the front side of the casing 71 (Figs. 31 and 33). A distance sleeve 219 (Fig. 32) on the bearing screw holds the tensioning arm at the proper distance from the casing 71 so that a cam 220 at the upper end of the tensioning member 207 is in the path of the arm 218. A pin 221 is riveted into the arm 218 to which a spring 222 is attached. The spring 222 is anchored on a pin 223 secured in the casing 71 and permanently turns the arm 218 clockwise about its bearing screw 217, the normal position of the arm being defined by a pin 224 riveted into the casing 71.

The operation of the tensioning means for the controlling members of the complementary totalizer according to the construction illustrated in Figs. 31 to 34

Let it be assumed that the accounting operation in the first line of the form F (Fig. 15) has been completed, that is, that the value "115.15" has been typed and that in consequence the controlling members of the complementary totalizer 2 are in the positions shown in Fig. 28. When now the carriage return is positively effected, the lower end of the arm 218 (Fig. 33) acts on the incline 220*a* of the cam 220, swinging the tensioning member 207 clockwise about its bearing screw 211 and into the position shown in Fig. 33, and putting tension on the spring 204. During the further movement of the paper carriage to the right, the lower end of the arm 218 slides on the horizontal upper edge 220*b* of the cam 220, holding the tensioning member 207 in its swung-out position (Fig. 33). When the arm 218 has cleared the upper edge 220*b* of the cam, the tensioning member 207, under the action of the tensioned spring 204, swings back into its initial position according to Fig. 31 about the bearing screw 211, and the upper edge 216*a* (Fig. 34) of its portion 216 acts on the roller 44 of the reversing lever 13. The controlling members of the complementary totalizer 2 are returned into the normal positions illustrated in Figs. 27 and 29 from the positions according to Fig. 28. In consequence of the abrupt swinging up of the tensioning member 207 a safe return of the controlling members of the complementary totalizer 2 can be relied on. As mentioned, the roller 193 of the retaining plate 194 rolls on the rib 199 of its front plate 200 and this prevents rising of the complementary totalizer 2.

An incline 225 (Fig. 34 and 33) is provided at the right of the crooked portion 216 of the tensioning member 207. The object of this incline is to throw the controlling members of the complementary totalizer 2 back into their normal positions if the operator, with the paper carriage in its final position at the right of the machine, knocks inadvertently against the roof-shaped cam 74 (Fig. 29) of the catch 150, so that the controlling members are moved from their initial positions as shown in Figs. 27 and 29, into the reversed position shown in Fig. 28. In this case, when the paper carriage is tabulated, the roller 44 of the reversing lever 13 rises on the incline 225 at the tensioning member 207 and the controlling members of the complementary totalizer 2 are positively returned into their initial positions (Fig. 27), the spring 204 being so strong as to prevent swinging of the tensioning member 207.

When, during the tabulation of the paper carriage, the arm 218 strikes the cam 220 of the tensioning member 207, the arm yields anticlockwise against the action of its spring 222 so that the tensioning member 207 is not swung.

General description of the constructions illustrated in Figs. 35 to 43

In order to promote a quick understanding of the object for which the fifth to seventh constructions are provided, a short reference to the operation of the first construction, as illustrated in Figs. 1 to 13, and explained with reference to Figs. 15 to 26, is required. This will be explained for the calculating example

$$\begin{array}{r} 0\ 000\ 000.00 \\ -9\ 999\ 999.99 \\ -\qquad\qquad 1 \\ \hline \end{array}$$

In the right-hand final position of the paper carriage of the typewriting-calculating machine which is the initial position for accounting work, the four-armed lever 102 which supports the screens 112 and 113 (Fig. 35) has been moved into the position illustrated in Figs. 35 and 36 by the head 99 of the cam 97 at the driving wheel 96 for the highest calculating place in the complementary totalizer 2, as described in the section entitled "The operation of the complementary totalizer and the parts of the mechanism cooperating with it" for the first construction illustrated in Figs. 1 to 13. In this position, the screen 112 exposes the set of negative numeral wheels 116—which indicates "zero" in this case and the screen 113 conceals the set of positive numeral wheels 115 (Figs. 36 and 44) which in this case indicate "9". In conformity with the example, let it be assumed that the value "9 999 999.99" is to be entered subtractively in the complementary totalizer which, by way of example, has ten places. The numeral wheels in both sets 115 and 116 are rotated for nine units in the direction of the arrow in Fig. 44, position *b*, so that the set of negative numeral wheels 116 indicates the value "9 999 999.99" while the set of positive numeral wheels 115—which is concealed by the screen 113—shows the value "0 000 000.00". The cam 97 with its head 99, on the driving wheel 96 of the highest calculating place—which wheel rotates clockwise, has descended along the arcuate edge 100 of the arm 101 at the four-armed lever 102 and has occupied the position shown in Fig. 44, *b*.

For the next accounting operation, let it be assumed, by way of example, that the value "1" is also to be entered subtractively in the complementary totalizer 2. The numeral wheels at the lowest calculating place of both sets 115 and 116 of numeral wheels are rotated further for one unit in the direction of the arrows in Fig. 44, position *b*, and at the moment the numeral wheel of the lowest calculating place in the set of negative numeral wheels 116 is turned from "9" to "0", a tens transfer occurs which progresses from calculating place to calculating place. At the moment the numeral wheel at the highest calculating place in the set of negative numeral wheels 116 is about to move from "9" to "0", that is the capacity of the complementary totalizer 2 is overstepped, the cam 97, 99 of the driving wheel 96 at the highest calculating place—which rotates clockwise—strikes the lower or front end B of the arcuate slot 98 in the left-hand side plate 39 (Fig. 44, position *c*) of the column totalizer 2, arresting the rotation of this driving wheel 96 at the highest calculating place. This positive arresting of the driving wheel 96 caused damage to the mechanisms of the totalizer and to the calculating mechanism concealed by the casing 51 and so led to miscalculations.

To avoid accidents of this kind, the following arrangements have been made according to the invention.

Description of the members in the fifth construction, as shown in Figs. 35 to 38

A shaft 230 is screwed into the right-hand side plate 3 (Figs. 36 and 37) of the complementary totalizer 2 at one end. Its other end extends through a circular hole 235 in the left-hand side plate 39 of the complementary totalizer 2 and is supported by a bearing bracket 232 in which a hole 231 (Fig. 37) is made for its reception. The bearing bracket 232 has a circular recess 234 in its inner face and is secured to the left-hand side plate 39 of the complementary totalizer 2 by screws 233. The driving wheels for the several calculating places, including the driving wheel 96 for the highest place in the complementary totalizer 2, are mounted to rotate on the shaft 230. The head 99 of its cam 97 is free to rotate in the recess 234 in the bearing bracket 232 and in the hole 235 in the left-hand side plate 39 of the complementary totalizer 2, so that the driving wheel 96 can perform a full revolution without obstruction.

The head 99 of the cam 97 operates the screens 112 and 113 which alternately conceal the set of positive numeral wheels 115 and the set of negative numeral wheels 116 (Fig. 36) of the complementary totalizer 2 through the four-armed lever 102. This lever, and the members cooperating with it, have been fully described for the first construction according to Figs. 1 to 13 in the said section entitled "The operation of the complementary totalizer and the parts of the machine cooperating with it," and need not be described again here.

The overstepping of the capacity of the complementary totalizer when calculating "minus" values

As mentioned, in the initial position of the complementary totalizer 2 for accounting operations, the driving wheel 96, its cam 97, 99, the four-armed lever 102, and its screens 112 and 113 occupy the initial positions illustrated in Figs. 35 and 36 in which the set of negative numeral wheels 116 indicates "zero" and the four-armed lever 102 which carries the screens 112 and 113 has been so controlled by the head 99 of the cam 97 that the screen 112 exposes the set of negative numeral wheels 116 and the screen 112 conceals the set of positive numeral wheels 115 which in this case is at "9" (Figs. 35 and 36).

If, by way of example, several "minus" values are subtracted during a given accounting operation whose total is indicated by the set of negative numeral wheels 116, and if such values are entered up to the highest calculating place, the driving wheel 96 is rotated clockwise. The head 99 of its cam 97 slides along the arcuate edge 100 of the arm 101 at the four-armed lever 102, holding the lever in the position illustrated in Fig. 35. The operative connection 99, 100 is maintained as far as into the "9" position of the driving wheel 96, that is, until so many values have been entered into the highest calculating place, that its numeral wheel 116 indicates "9."

If during the subsequent operations of an accounting problem still more "minus" values are introduced for calculation, and if this oversteps the capacity of the complementary totalizer 2, the driving wheel 96 at the highest calculating place is rotated further in blockwise direction, until the zero position, or even beyond. The head 99 of the cam 97 releases the edge 100 of the arm 101 on the four-armed lever 102 so that the lever can swing clockwise about its bearing screw 103, so that the screen 112 conceals the set of negative numeral wheels 116 and the screen 112 exposes the set of positive numeral wheels, 115. This throwing-over of the screens indicates to the operator that he has overstepped the capacity of the complementary totalizer 2.

In this construction, as distinguished from the first construction, Figs. 1 to 13, the driving wheel 96 at the highest calculating place in the complementary totalizer 2 can rotate clockwise beyond a zero position and perform a complete revolution, without obstruction due to the circular hole 235 in the side plate 39 at the left of the complementary totalizer 2 and in this manner damage to the mechanisms of the totalizers and to the calculating mechanism of the machine covered by the casing 51 are avoided when the capacity is overstepped.

The overstepping of the capacity of the complementary totalizer when calculating "plus" values

Assume that all members of the complementary totalizer are in their normal positions according to Fig. 35, that is the complementary totalizer 2 has been "clear" written.

If several "plus" values are added during an accounting operation, the total of these values will be indicated by the set of positive numeral wheels 115.

In this case, in the first construction according to Figs. 1 to 13, and in the manner described in the section entitled "The arrangement of the screen-controlling mechanism at the complementary totalizer" due to the throwing-over of the four-armed lever 102 and its screens 112 and 113 from the position shown in Fig. 35 into the position shown in Fig. 38, in consequence of the addition of the "fugitive 1," the set of positive numeral wheels 115 is exposed, and the set of negative numeral wheels 116 is concealed.

If the operator calculates with repeated additions of "plus" values up to the highest calculating place, and the driving wheel 96 at that place is rotated anti-clockwise, and if he oversteps the

capacity of the complementary totalizer **2**, the cam **97**, with its head **99**, moves in the rear portion of the hole **235** in the left hand side plate **39** of the complementary totalizer **2** without interferring with any other parts, and so damage to mechanisms is avoided also in this case when the capacity of the complementary totalizer **2** is overstepped.

Description of the sixth construction, as shown in Figs. 39 and 40

In this construction, the four-armed lever **102** (Figs. 39 and 40) in addition to the other parts described in the section entitled "Description of the members in the fifth construction, as shown in Figs. 35 to 38" is equipped with a fifth arm **102***a* which, with the arm **101**, forms an arcuate fork and the spring **104** is dispensed with.

In the normal position of the parts of the complementary totalizer **2**, the controlling members occupy the normal positions illustrated in Fig. 39. The operation of the lever **102** when calculating "minus" values is similar to that described in the section entitled "The overstepping of the capacity of the complementary totalizer when calculating "minus" values.

When "plus" values are calculated, the driving wheel **96** at the highest calculating place is rotated into the position shown in Fig. 40 from the position shown in Fig. 39. The head **99** of its cam **97** clears the edge **100** of the arm **101** and engages the inner edge **102***b* of the arm **102***a*, whereby the lever **102** is turned clockwise about its bearing screw **103**, and into the position Fig. 40. When more "plus" values are added as far as the highest calculating place, and the driving wheel **96** of that place is rotated anti-clockwise, the head **99** of the cam **97** on the wheel **96** slides along the edge **102***b* of the fifth arm **102***a*, holding the lever **102** in the position shown in Fig. 40.

As will appear from the above, the lever **102** which supports the screens **112** and **113** is positively thrown over by the head **99** of the cam **97** when calculating "plus" and "minus" values in the construction according to Figs. 39 and 40, and the spring **104** is not required.

Description of the members of the seventh construction, as shown in Figs. 41 to 43

In Figs. 41 to 43, a further construction of the means for controlling the screens **112** and **113** is illustrated whose arrangement will be described in the following:

Arranged at the left-hand side of the driving wheel **96** of the highest calculating place, a camplate **236** is arranged (Figs. 41 to 43). A cam groove **237** is made in the camplate **236**. A pin **238** engages in the cam groove **237** which has two concentric portions of different fradi, and an ascending portion **239** and a descending portion **240** connecting the concentric portions. The pin **238** extends through a slot **241** in the left-hand side plate **39** of the complementary totalizer **2** and is secured in a link **242**. At its lower end, the link **242** has a fork **243** which engages the shank of a headed screw **244** in the side plate **39** by which the lower end of the link is guided.

At the upper end of the link **242**, a rivet **245** is arranged by which the link is pivoted on a U-shaped portion of the arm **109** on the screen-supporting lever **102** which has but three arms in this instance. Preferably, a lug **246** is formed on the rearwardly extending arm **123** of the lever **102** in which an arcuate slot **247** is made. A guiding screw **248** which is screwed into the left-hand side plate **39** of the complementary totalizer **2**, engages in the slot **247** and serves as an additionas guide for the lever **102**.

The normal position of the controlling members when entering "minus" values

In the normal position, that is, when "minus" values are entered, the driving wheel **96** at the highest calculating place occupies the position shown in Fig. 41, if the corresponding negative numeral wheel **116** shows "zero." In this normal position, the pin **238** of the link **242** is on that portion of the cam groove **237** which has the larger radius. The link **242** and the lever **102** to which its is pivoted at **245**, together with the screens **112** and **113**, occupy their topmost positions (Fig. 41) in which the set of negative numeral wheels **116** is exposed by the screen **112**.

When entering "minus" values up to the highest calculating place, the driving wheel **96** at the highest calculating place of the complementary totalizer **2** is rotated clockwise and the large radius portion of the cam groove **237** moves past the pin **238**. If during these calculating operations the capacity of the complementary totalizer **2** is overstepped, the ascending portion **239** of the cam groove **237** reaches the pin **238** and moves the link **242** down at the moment the numeral wheel **116** at the highest calculating place moves from "9" to "0" until the pin **238** slides into the small-radius portion of the cam groove **237**. The lever **102** is swung clockwise about its bearing screw **103**, the screen **113** exposing the set of positive wheels **115** and the screen **112** concealing the set of negative numeral wheels **116**. This indicates to the operator that the capacity of the column totalizer **2** has been overstepped.

The position of the controlling members when entering "plus" values

When entering "plus" values, first the driving wheel **96** at the highest calculating place in the complementary totalizer **2** is turned through one unit and anti-clockwise from the position in Fig. 41 to that in Fig. 42. This is effected by adding the "fugitive **1**" in the set of positive wheels **115** and by the progressive tens transfer effected thereby. During this anti-clockwise movement of the driving wheel **96** the ascending portion **240** of the cam groove **237** in the camplate **236** at the side of the driving wheel **96** acts on the pin **238** and moves the link **242** down (Fig. 42). By the rivet **245** the link **242** swings the lever **102** clockwise. The screen **112** on the lever **102** now conceals the set of negative numeral wheels **116**—which had been exposed—and exposes the set of positive numeral wheels **115** which had been concealed. When adding positive values up to the highest calculating place and if the capacity is overstepped, the small-radius portion of the cam groove **237** moves past the pin **238** without influencing it in any way.

The following arrangement has been provided for indicating to the operator, before he begins with an accounting operation that the complementary totalizer **2** is ready for operation, that is, is in its initial condition in which the set of negative numeral wheels **116** is at "zero," the screen **112** exposes this set, and the screen **113** conceals the set **115**, as shown in Figs. 35, 36 and 39.

Description of the "ready" indicator in the complementary totalizer

A shaft 250 (Figs. 35, 37 and 38) is secured in side plates 3 and 39 of the complementary totalizer 2, and an indicator arm 251 is mounted to swing about, and to slide on, the shaft 250 near the inner side of the left-hand side plate 39 (Fig. 36). A cam 252 at the lower side of the arm 251 is arranged for cooperation with the cam 97 of the driving wheel 96 at the highest calculating place. The front end 253 of the arm 251 is crooked to the right and a plate 254 at the free end of the crooked portion bears a mark 255, preferably in white. In the initial position of the arm 251 (Fig. 35) the cam 97 on the driving wheel 96 engages the cam 252 on the arm and holds the arm in elevated position in which its mark 255 is visible through an inspection hole 257 in the front plate 256 of the complementary totalizer 2 (Fig. 36), indicating to the operator that the complementary totalizer 2 is ready for operation. When the driving wheel 96 at the highest calculating place is rotated, the cam 97 of the wheel releases the cam 252 on the arm 251, and the arm swings clockwise about the shaft 250 by gravity, until a lug 258 at its lower side is arrested by a stop 259 riveted into the left-hand side plate 39 of the complementary totalizer 2 (Fig. 38). The mark 255 on its plate 254 is now concealed by the solid portion of the front plate 256 below the hole 257.

The position of the "ready" indicator when the complementary totalizer is in its initial condition

In the initial or normal condition of the complementary totalizer 2, the "fugitive 1" has been added in the set of negative numeral wheels 116, and the members 96, 97—99, and 102 which control the screens 112 and 113, are in the positions illustrated in Fig. 35. In this position, cam 97 of the driving wheel 96 at the highest calculating position of the complementary totalizer 2, acting on the cam 252 of the arm 251, raises the arm into the position illustrated in Fig. 35 in which its mark 255 is in line with the inspection hole 257 (Fig. 36). The mark 255 which now appears in the hole 257, indicates to the operator that the complementary totalizer is in the initial position at the beginning of a calculating operation.

The position of the "ready" indicator if the complementary totalizer is not in the proper initial condition

If, due to any cause, for instance, through inadvertence of the operator at the beginning of an accounting operation, the controlling members of the complementary totalizer 2 have been so operated that the "fugitive 1" has been added to the set of positive numeral wheels 115, the parts 96, 97—99, and 102, positively occupy the position illustrated in Fig. 38.

In this position, the cam 97 of the driving wheel 96 at the highest calculating place in the complementary totalizer 2 has released the cam 252 on the indicator arm 251 which now, by gravity, swings clockwise about its shaft 250 until the lower end of its lug 258 is arrested by the stop pin 259. The mark 255 is now below the inspection hole 257 in the front plate 256 (Fig. 38) and is not visible to the operator. This indicates that the complementary totalizer 2 is not in the proper initial position for operation. The proper positioning of the members in the complementary totalizer 2 is effected positively by the movement of the paper carriage of the typewriting calculating machine.

The "ready" indicator according to the invention which has just been described, prevents wrong accounting by the operator.

The capacity-overstepping indicator

Fig. 45 shows an indicator by which the operator is advised that the capacity of the complementary totalizer 2 has been overstepped, and whether the calculation is positive or negative.

An indicator arm 261 is mounted to swing about a screw 260 in the left-hand side plate 39 of the complementary totalizer 2. At its free end, the arm is equipped with a sector bearing the marks "1P", "0P", "1N" and "0N" which can be observed through an inspection hole 264 in the front plate 256 of the complementary totalizer 2. A spring 266 tends to pull the arm 261 against a stop 272 in the side plate 39. At its rear end, the arm 261 is equipped with a fork-shaped member having two circular steps 263 and 267. Two cams 270 and 270*a* are secured to the arms of the fork by a U-shaped bracket 269 and 269*a*.

A pin 262 on the head 99 of the cam 97 on the driving wheel 96 at the highest calculating place in the complementary totalizer 2 controls the arm 261 which is mounted to swing about the screw 260 (Fig. 45) in the left-hand side plate 39 of the complementary totalizer 2.

In the proper initial condition of the complementary totalizer 2 in which the screen 112 exposes the set of negative numeral wheels 116 and the set of negative numeral wheels 115 is concealed by the screen 113 (Fig. 35), as shown in Figs. 35 and 36, the driving wheel 96 of the highest calculating place occupies the position illustrated in Fig. 45 in which the pin 262 of the cam 97, 99 acts on the step 263 of the arm 261 and holds the arm in the position illustrated in Fig. 45. In this position of the arm, the mark "0N" is visible in the inspection hole 264, indicating that no capacity has yet been overstepped, and the calculation is negative. While "minus" values are calculated, the arm 261 remains in this position until the numeral wheel which is allotted to the highest calculating place in the set of negative numeral wheels 116, shows "9", In this "9" position, the cam 97, 99 is in the position D shown in dotted lines in Fig. 45. If more "minus" values are entered and the capacity of the complementary totalizer 2 is overstepped, the driving wheel 96 at the highest calculating place rotates further into the zero position, or beyond, in the direction of the arrow. Now the indicating arm 261 under the action of the spring 266 rocks clockwise until the step 265 of the cam 270*a* abuts on the pin 262 of the cam 97, 99 of the wheel 96. The mark "1N" is now in line with the inspection hole 264, indicating to the operator that he has overstepped the capacity one time in the negative sense.

Assuming that the parts of the complementary totalizer 2 (Fig. 45) are in their initial positions, and that positive values are to be entered the driving wheel 96 of the highest calculating place is rotated against the arrow and releases the step 263 of the indicator arm 261 by the pin 262 on its cam 97, 99, and the spring 266 swing the arm 261 clockwise, until its step 267 is arrested by the pin 262. When more positive values are entered into the highest calculating place so that the driving wheel 96 rotates further in the direction of the arrow, the pin 262 slides along the edge 268 of the cam 270 which is connected to

the arm 261 by the U-shaped bracket 269 where it remains until it arrives in the position E shown in dotted lines and corresponding to the "9" position of the numeral wheel in the highest calculating position of the set of negative numeral wheels 116.

In both cases, the warm 261 occupies that position in which the mark "0P" is visible through the inspection hole 264. The operator that the calculation is positive, but the capacity of the complementary totalizer has not been overstepped.

If subsequently more positive values are entered into the complementary totalizer 2, and the capacity of the totalizer is overstepped, the driving wheel 96 at the highest calculating place is rotated further into the zero position or beyond against the arrow. When the numeral wheel moves from "9" to "0", the pin 262 leaves the edge 268 of the cam 270 and the spring 266 swings the arm 261 clockwise until the lower edge 271 of the cam bears against the pin 262. In this position the arm 261 is arrested by the stop pin 272 and the mark "1P" becomes visible in the inspection hole 264 advising the operator that he has overstepped the capacity one time in the positive sense.

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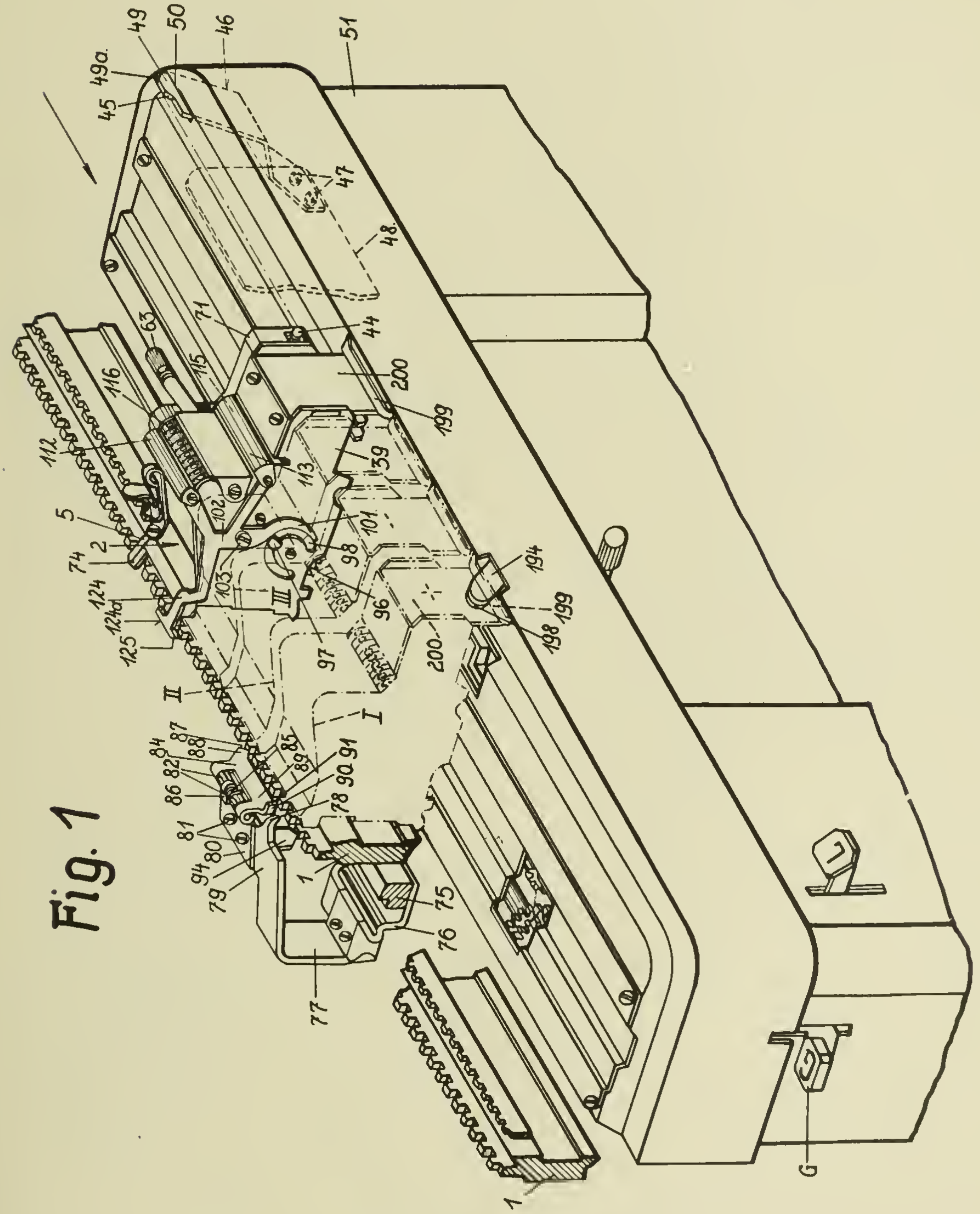

Fig. 1

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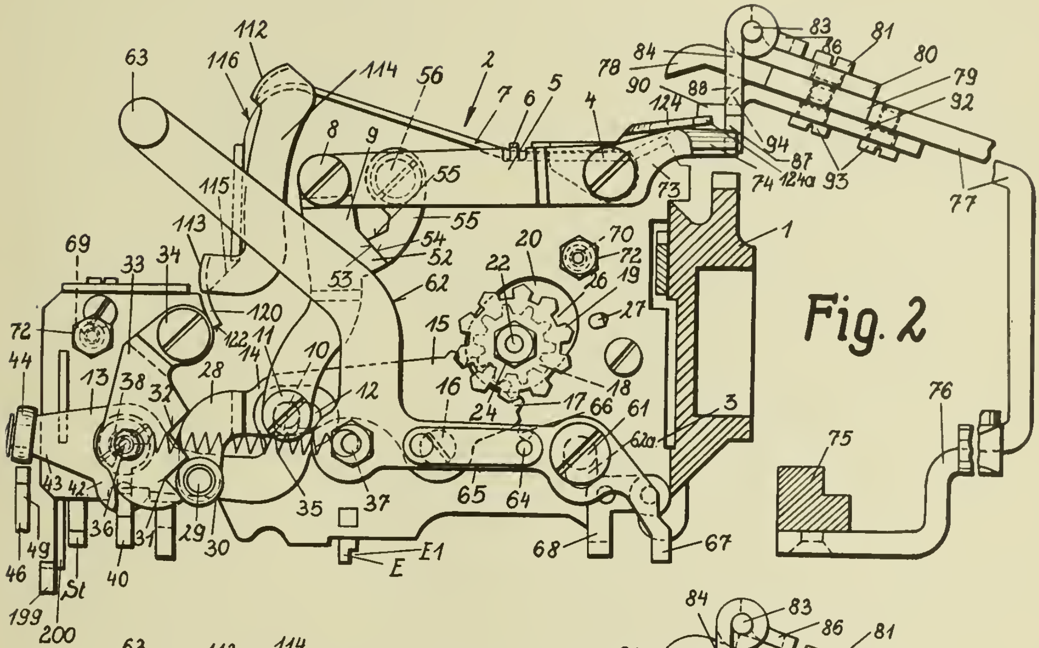

Fig. 2

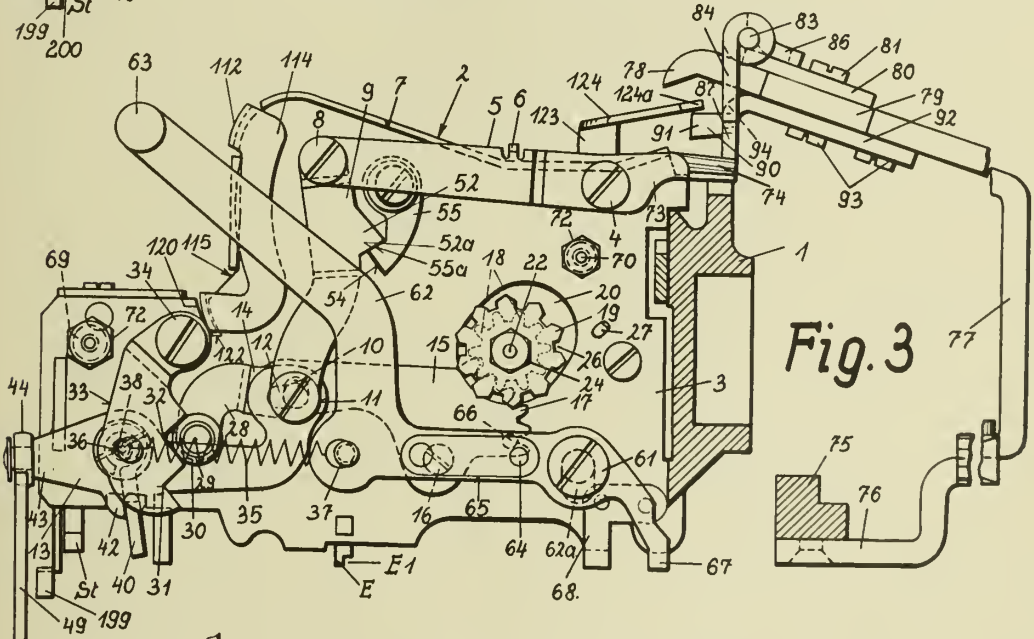

Fig. 3

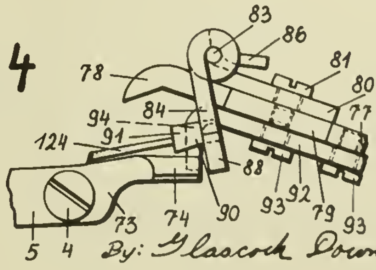

Fig. 4

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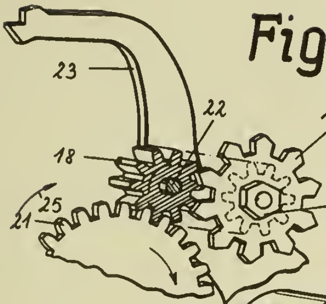
Fig. 6

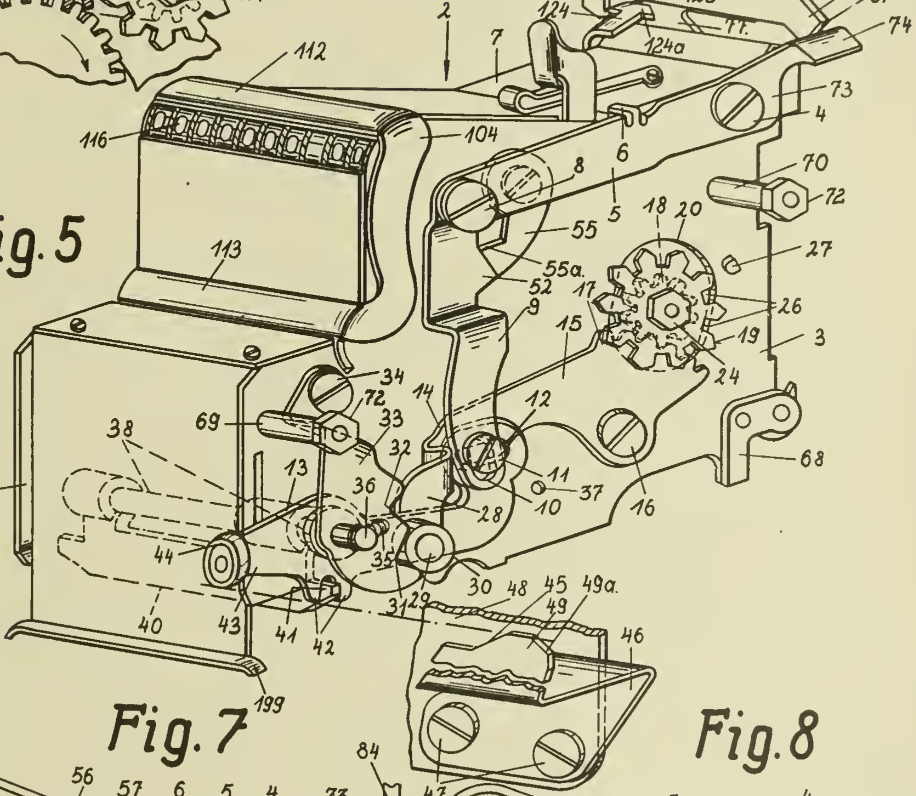
Fig. 5

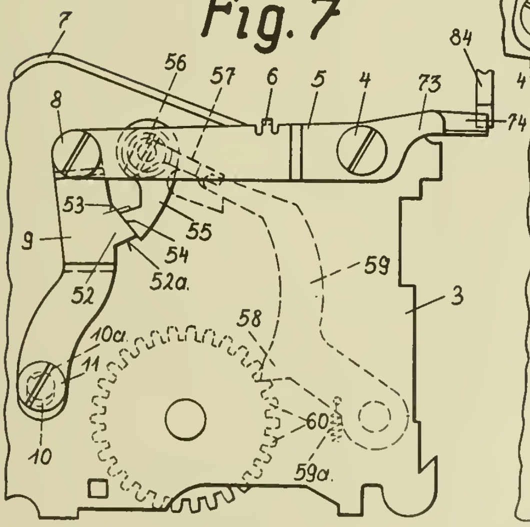
Fig. 7

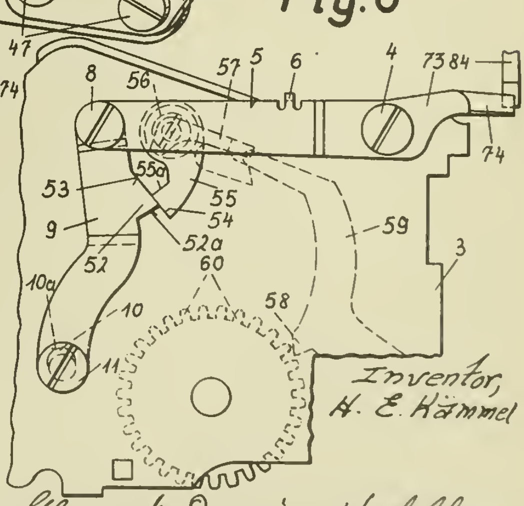
Fig. 8

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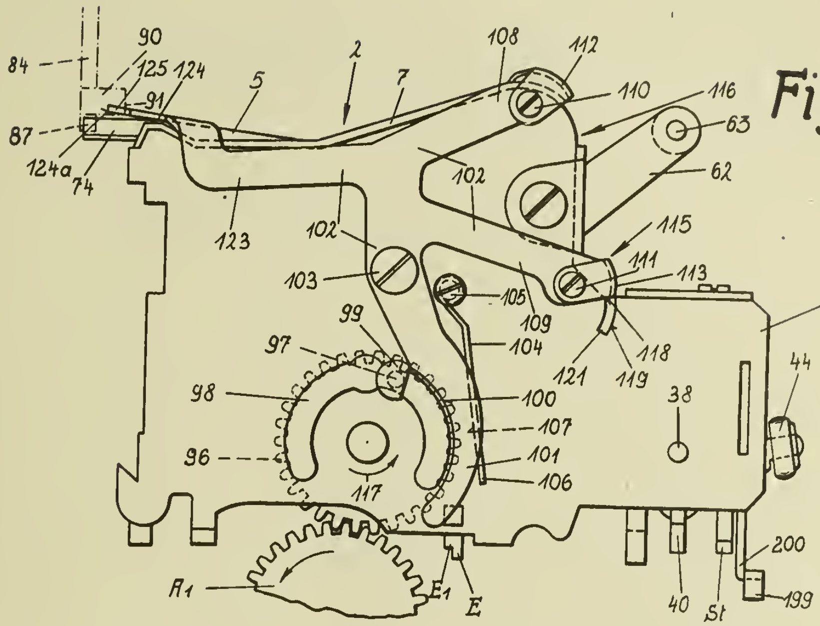
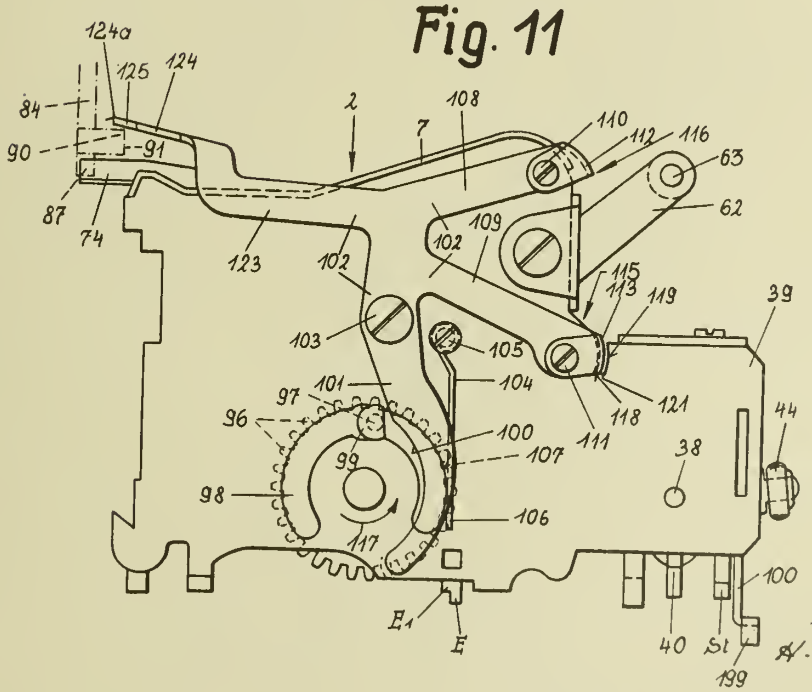


Fig.9

Fig. 11



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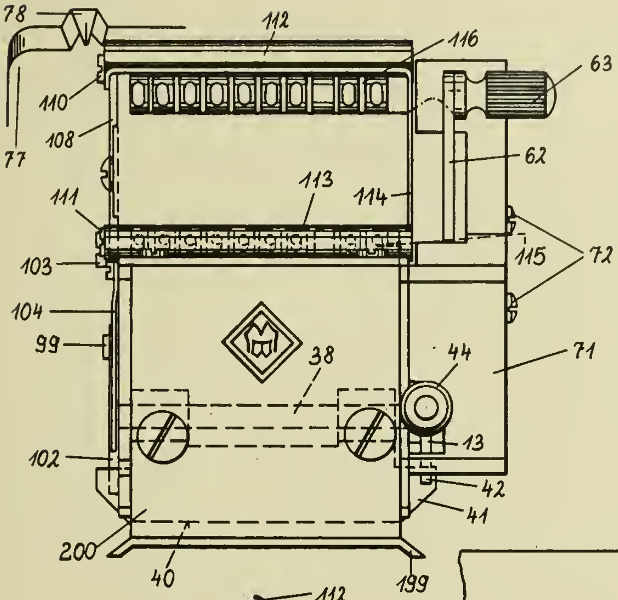
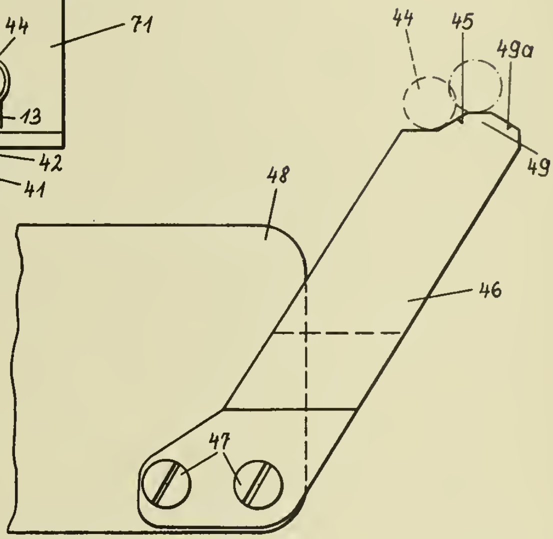


Fig. 12



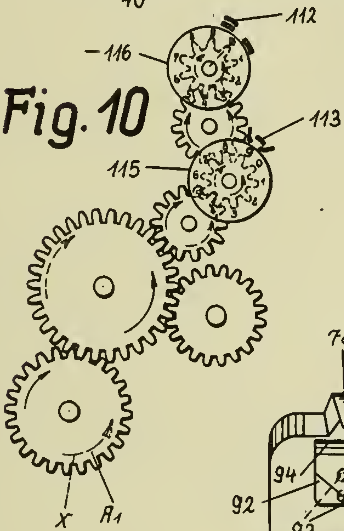


Fig. 10

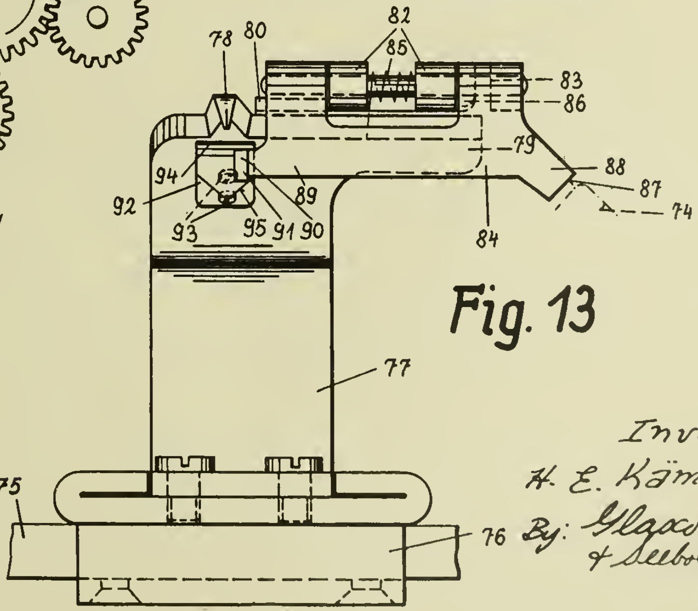


Fig. 13

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Fig. 14

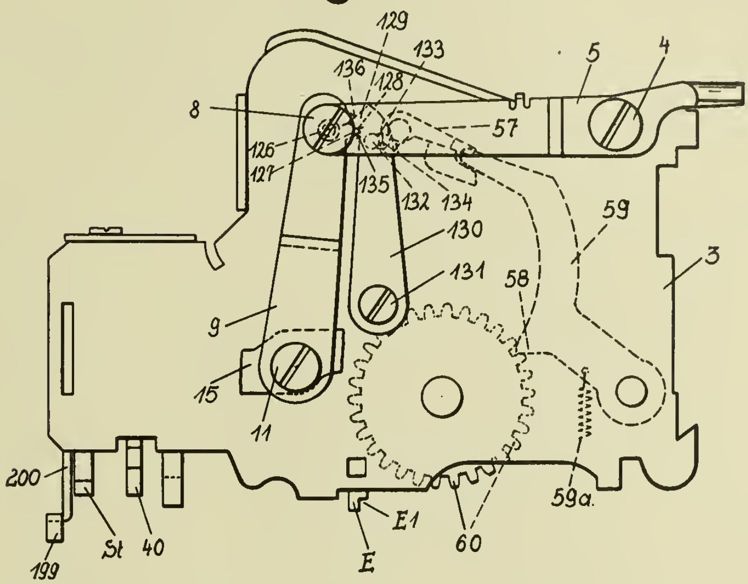

Fig. 15.

A	B	C	D	
Debit	Credit	Old Debit	New Debit	
	135.25	20.10	115.15 *	
525.32		115.15	410.17 *	F

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Fig. 16

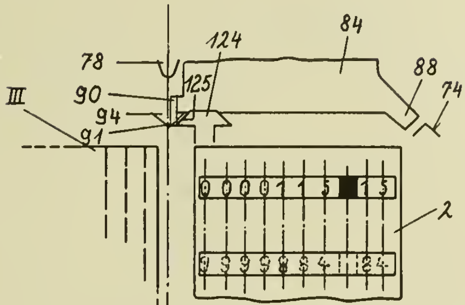


Fig. 17

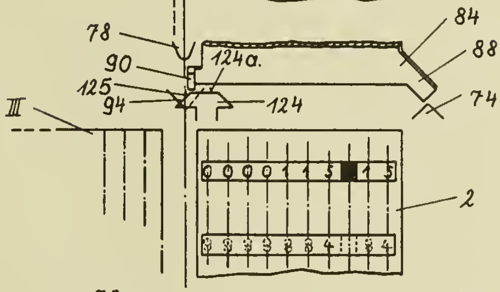


Fig. 18.

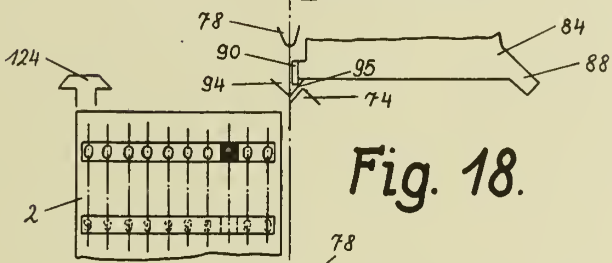


Fig. 19

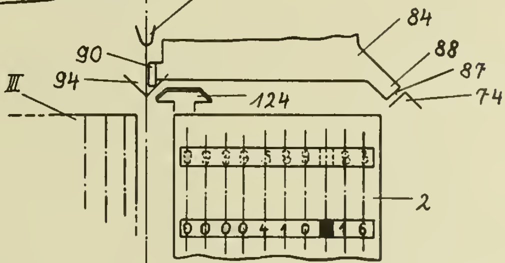
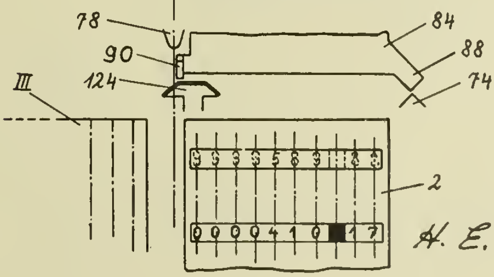


Fig. 20



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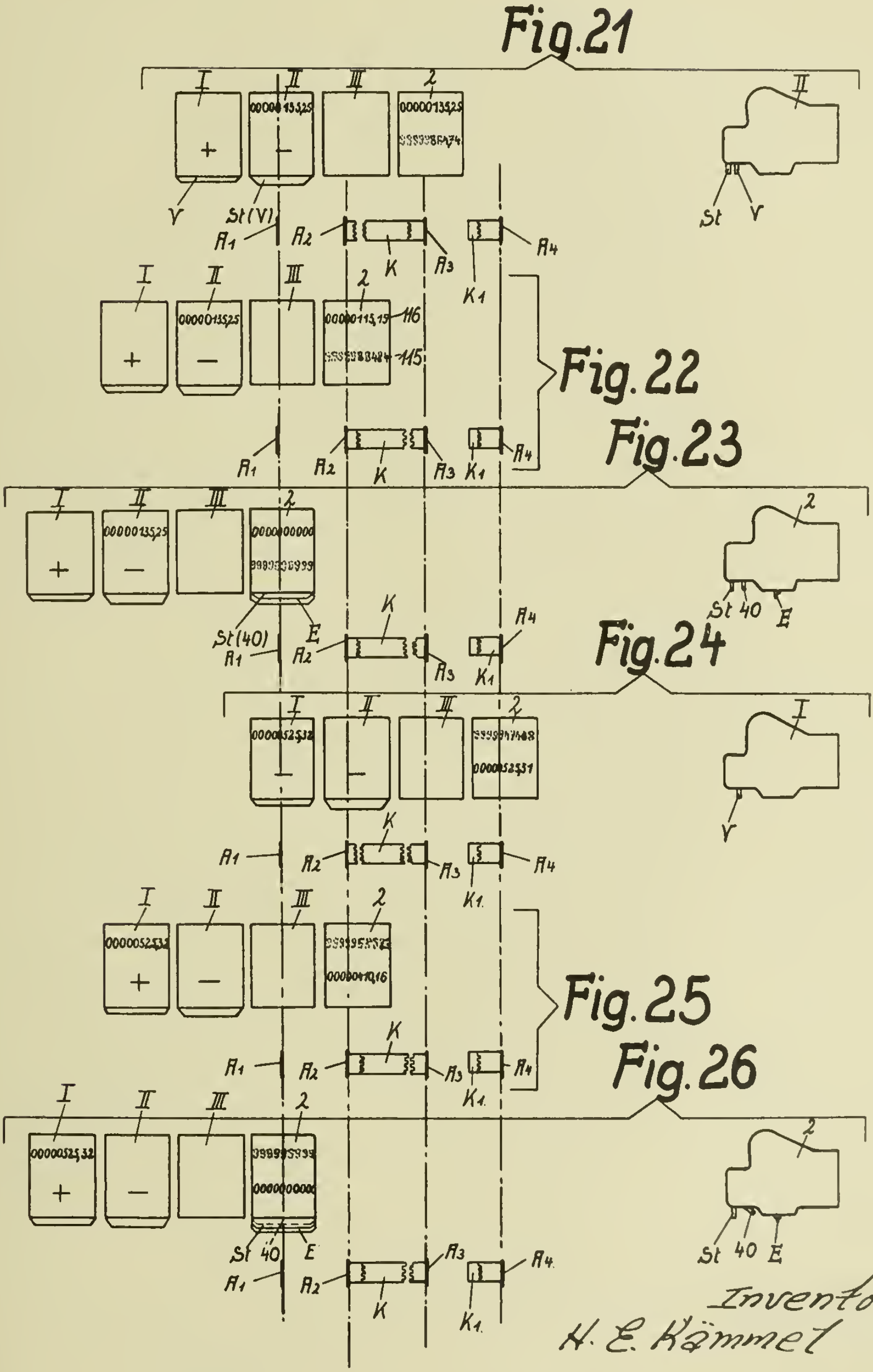

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Fig. 27

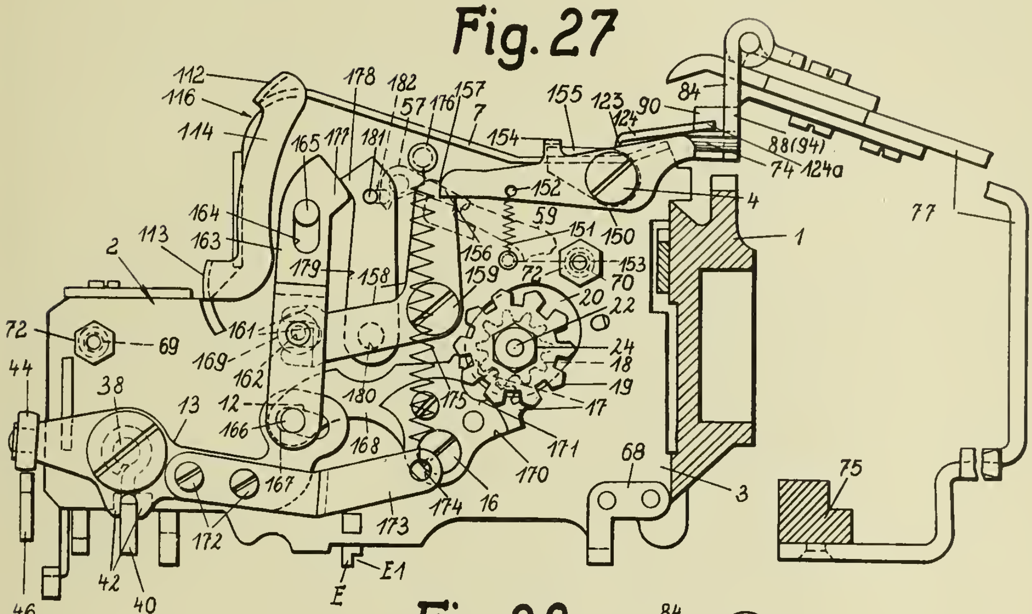

Fig. 28

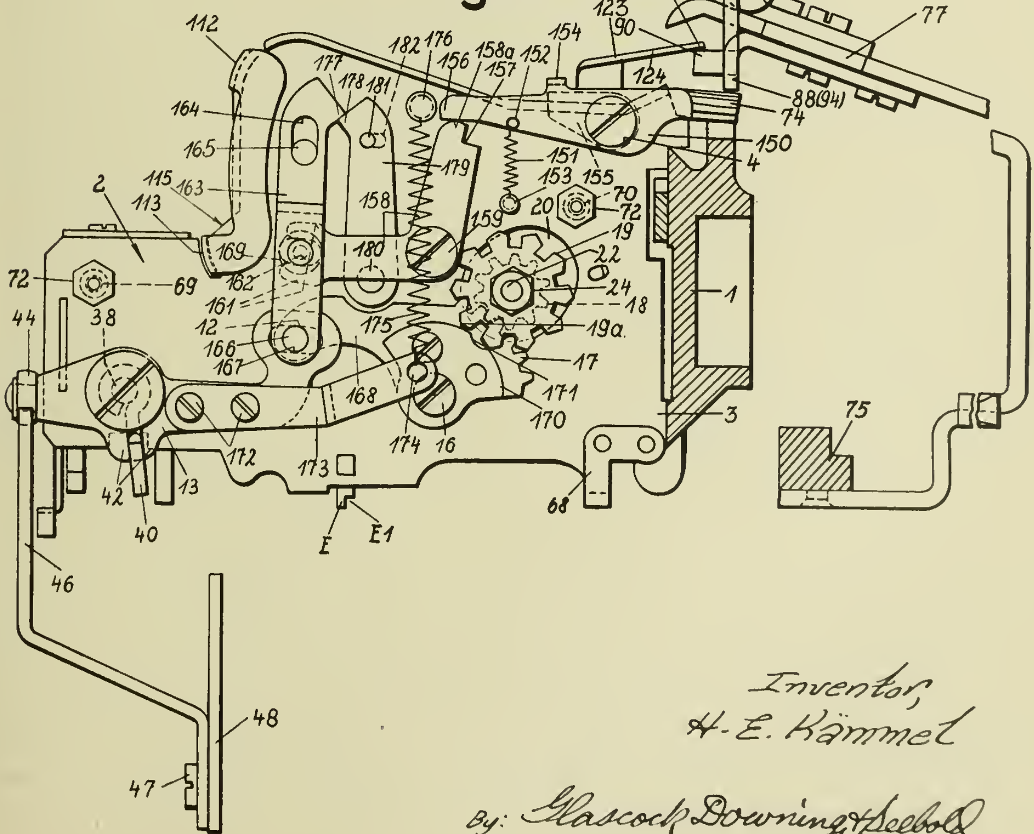

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Fig. 29

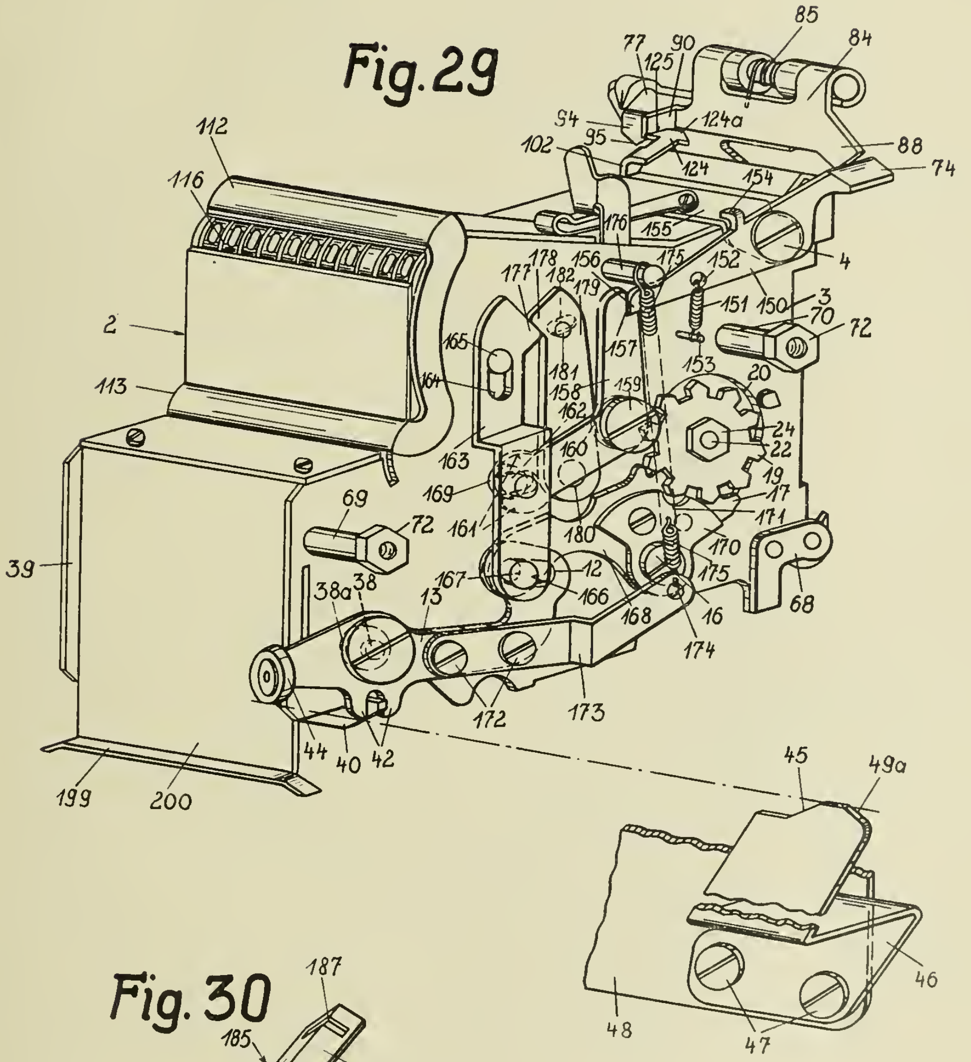
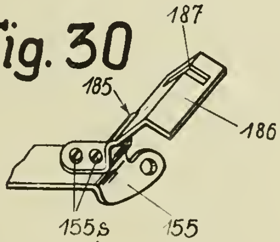


Fig. 30



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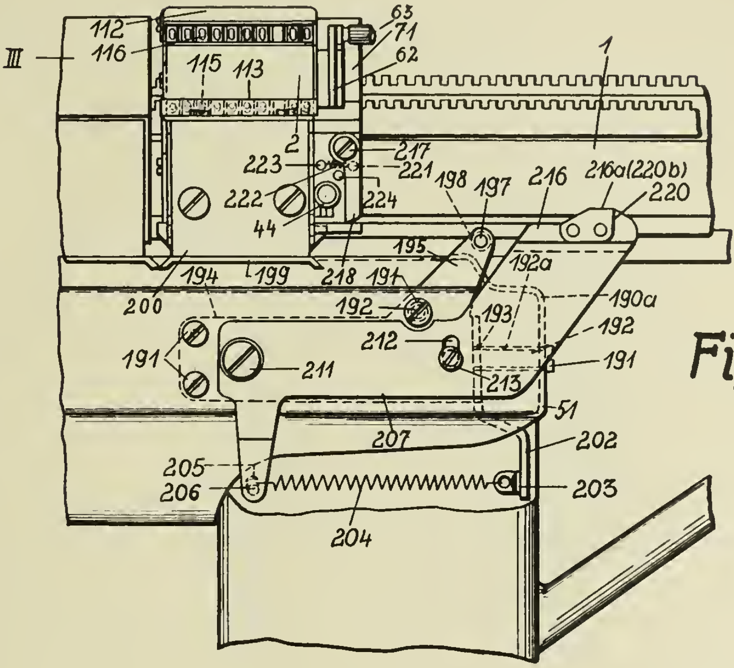

Fig. 31

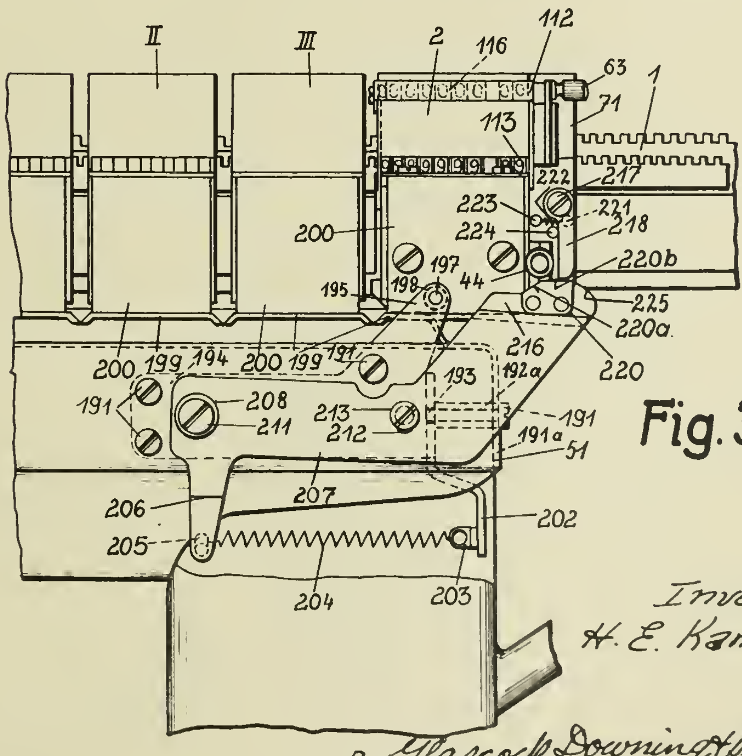

Fig. 33

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Fig. 32

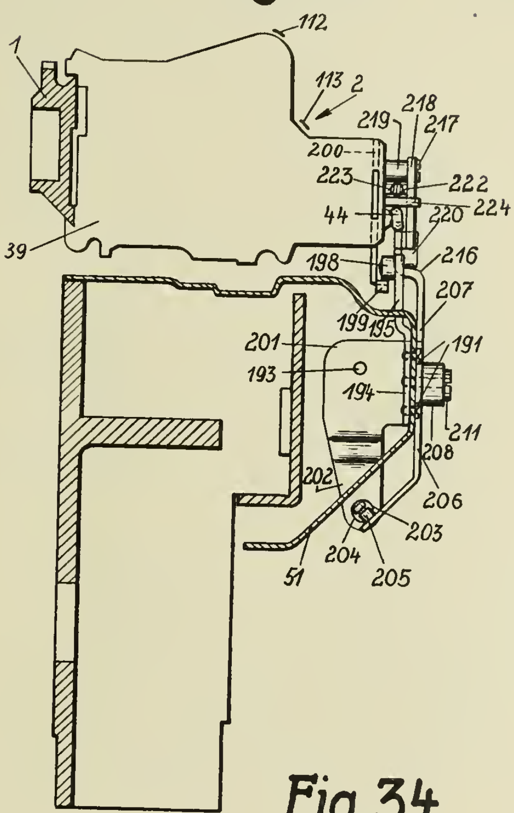
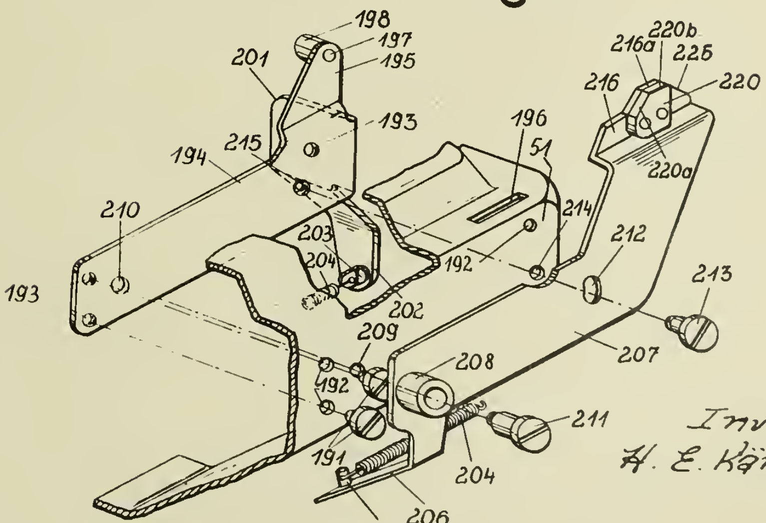


Fig. 34



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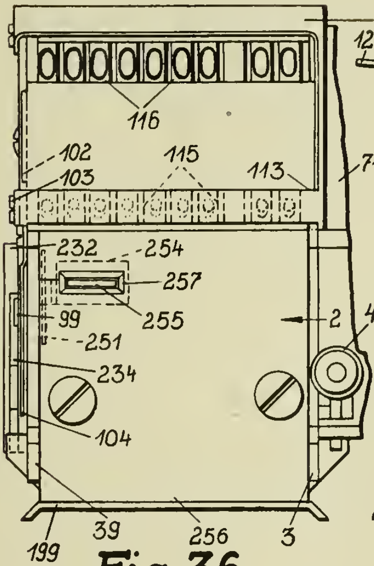


Fig.36

Fig.35

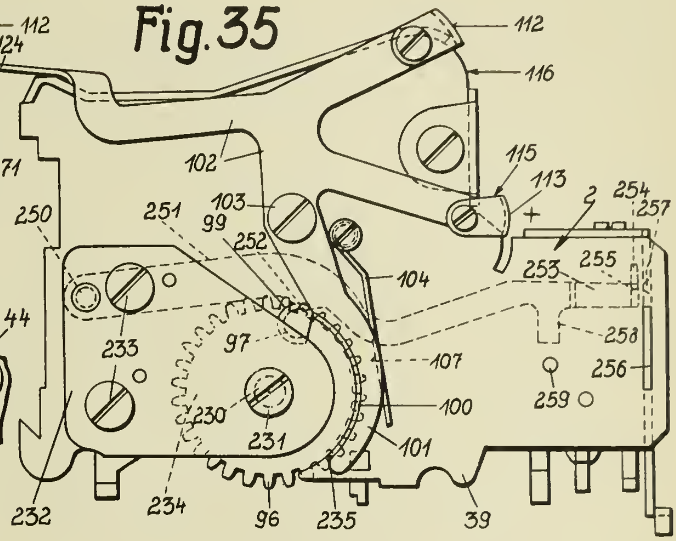
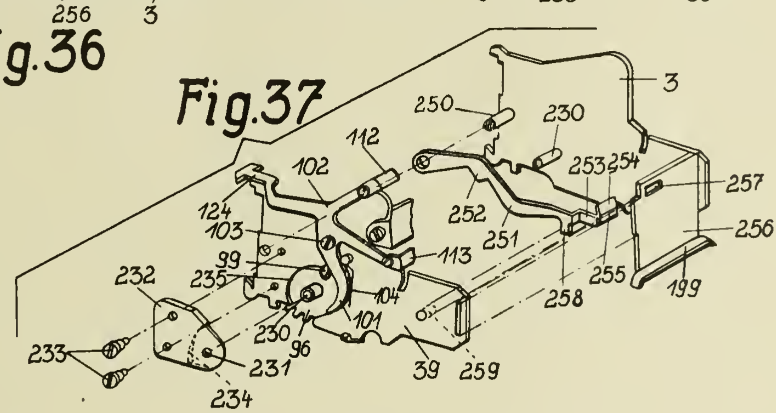


Fig.37



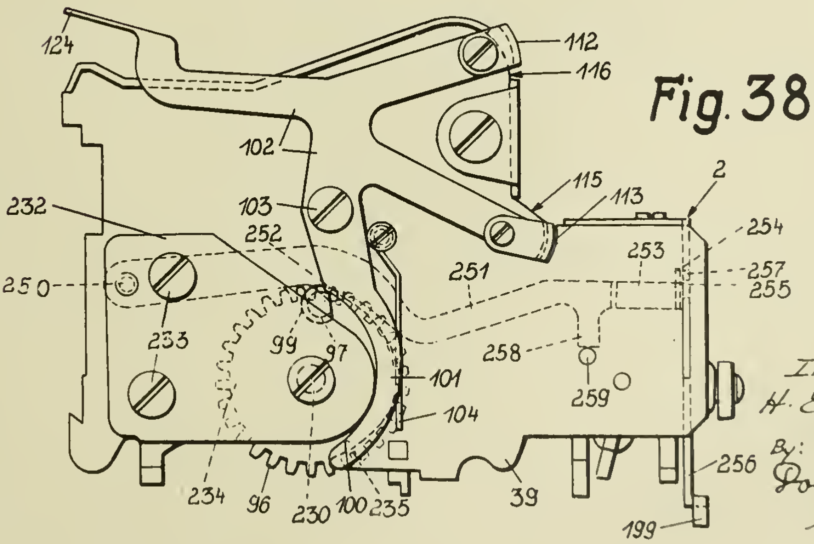


Fig. 38

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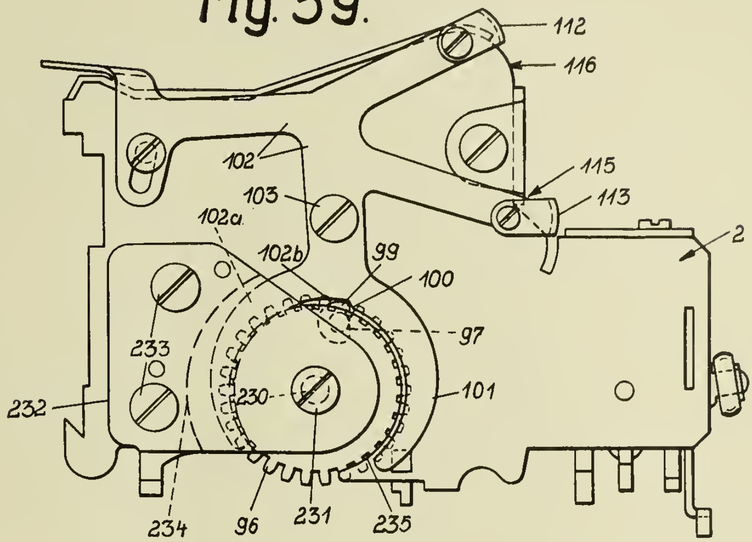
Fig. 39.



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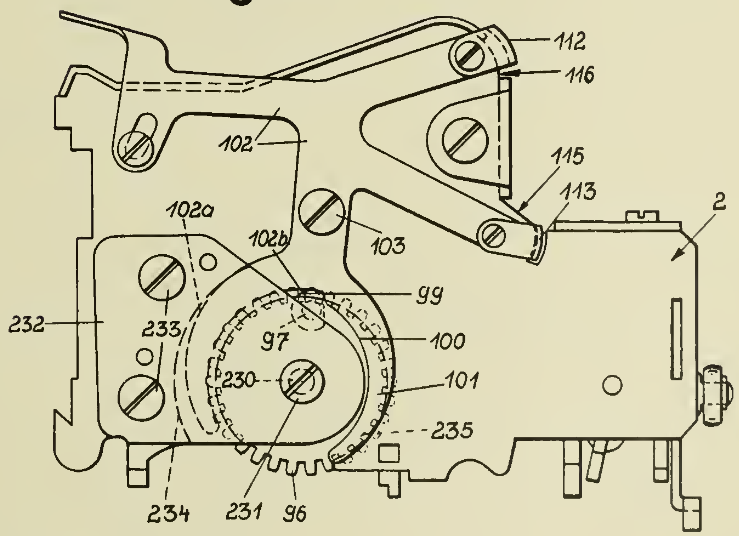

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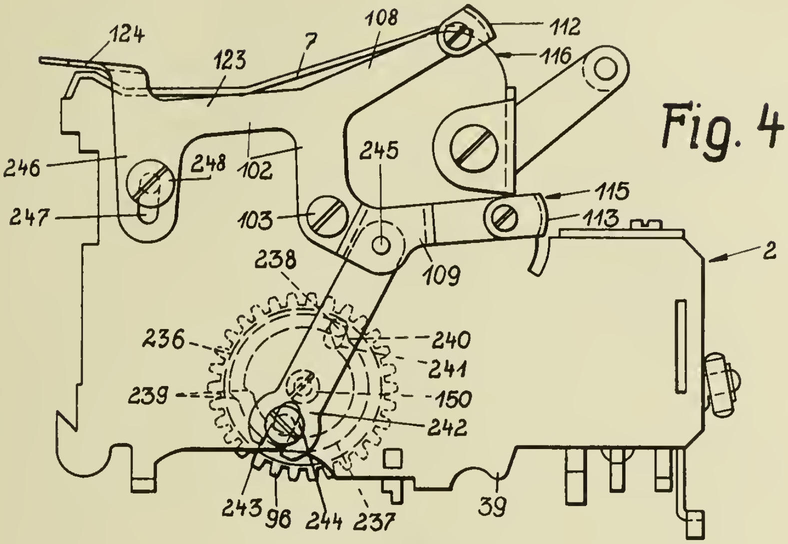

Fig. 41

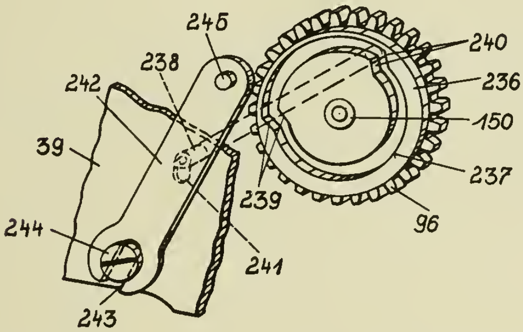

Fig. 43

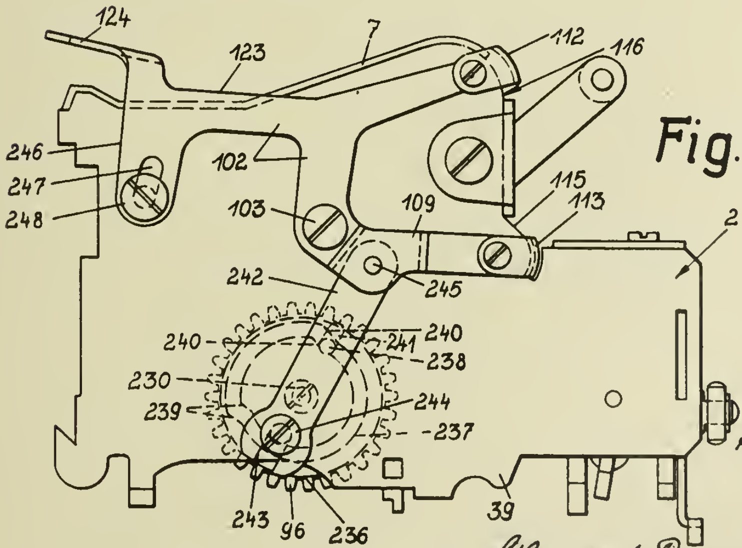

Fig. 42

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Fig. 44.

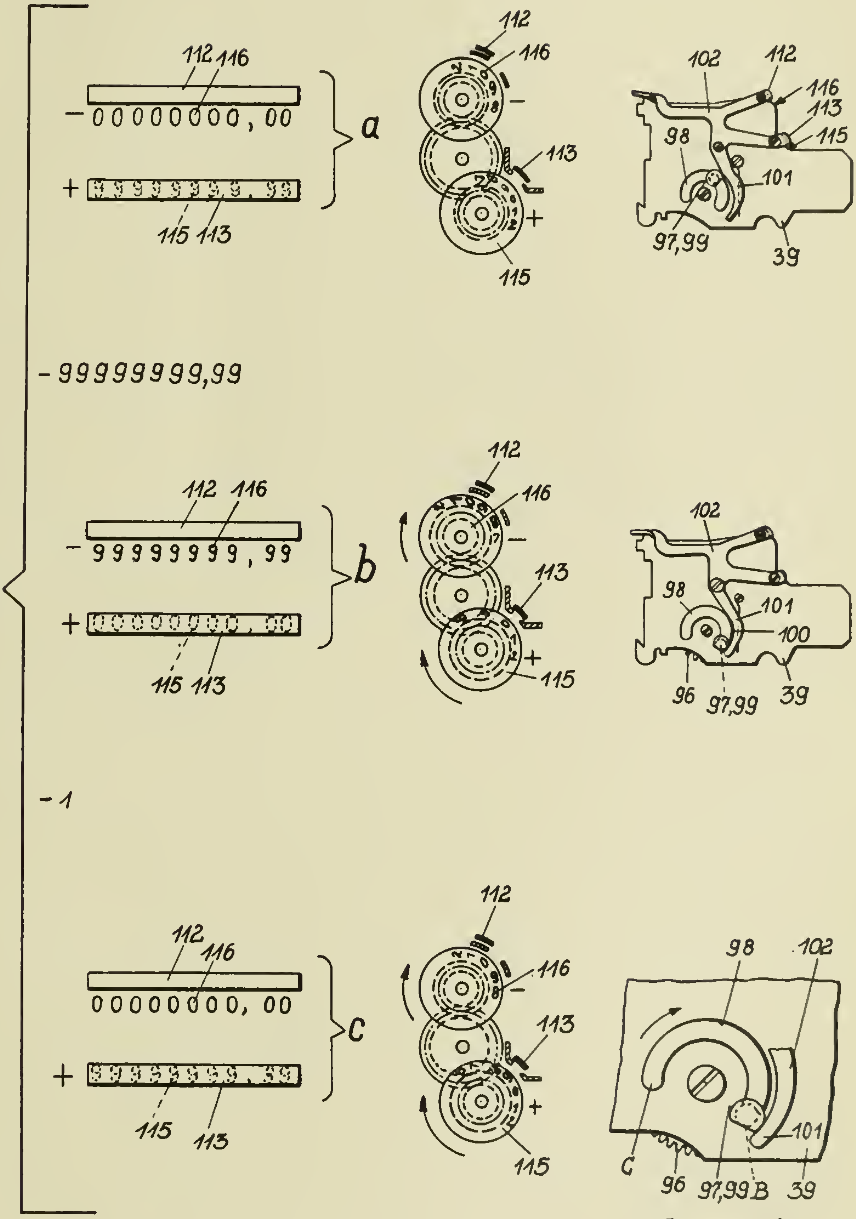

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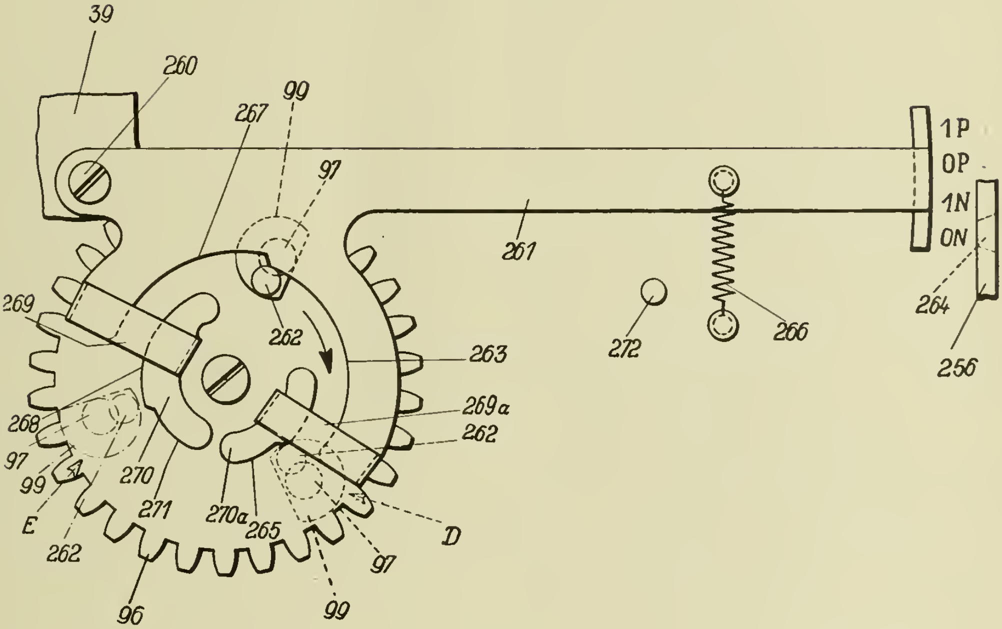
Fig. 45



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Published May 25, 1943 Serial No. 260,249

ALIEN PROPERTY CUSTODIAN

AERIAL FOR MOTOR VEHICLES

Johannes Gäbler, Stuttgart-Unterturkheim, Germany; vested in the Alien Property Custodian

Application filed March 7, 1939

The invention relates to an aerial, for operation with high frequency oscillations, for motor vehicles having a bodywork of pressed material. Principal objects of the invention are to permit of the aerial being applied in particularly simple fashion, or to utilise existing parts of the body as the aerial.

According to the invention, in motor vehicles with bodywork of pressed material, either metal insertions or sprayed-on or stuck-on electrically conducting materials are used as the aerial and are so contrived that the lead-in to the receiving apparatus can be effected from a suitable point. The metallic insertions may be such that they serve not only as an aerial, but also at the same time as stiffeners for the vehicle body. When pressed material is used for the production of bodies, it is possible to stick or spray electrically conducting materials directly to the insulating walls and, in some cases, to protect the same from damage by an insulating coating which may also be sprayed-on and which forms at the same time the normal interval or external covering.

Screening of the aerial necessary to avoid interference may be effected in simple manner, by accommodating the conductors in separate ribs or hollow spaces in the bodywork of pressed material. Thus harmful influence upon the aerial is avoided to a considerable extent.

In a further constructional example, separate conductors are stretched between pressed supporting parts on the bodywork, in which case these supporting parts may be provided from the start with recesses or projections for the reception of the conductors forming the aerial. Also, the aerial may be constructed so that existing stiffening insertions are connected together with stuck-on or sprayed-on electrically conducting materials which thus represent an extremely effective arrangement for the reception of high-frequency oscillations.

The particular advantage of the above-described aerial arrangement resides in the simplicity, reliability and cheapness of production. Also, the aerial parts are protected against any damage by external influences and may be applied completely invisibly without the necessity for providing special structural parts. By sticking-on or spraying on electrically conducting materials, the aerial can be applied subsequently at any time without any structural alterations whatever.

Various embodiments of the invention by way of example are illustrated diagrammatically in the drawings, in which:—

Figure 1 is an elevation of a vehicle body made of pressed material and fitted with one form of aerial.

Figure 2 is an inverted plan of the interior of a vehicle roof fitted with another form of aerial.

Figures 3 and 4 are longitudinal sections of the vehicle roofs with other forms of aerial and,

Figure 5 is a section to a larger scale of part of a vehicle roof provided with aerial supports.

In Figure 1, the body *a* has a roof part *b* which is made of pressed material and which, for example, encloses the pressed-in aerial *c*. The electrically conducting materials constituting the aerial *c* may serve at the same time for stiffening the body or the body parts.

In Figure 2, the interior of the vehicle roof *b*, has stiffening ribs *d*. In the panels between these ribs, surfaces *e* of electrically conducting materials are applied to the panel faces by spraying or the surfaces *e* may be stuck to such panel faces. The surfaces *e* are connected together by conductors f^1 and a common lead-in *f* passes from one of the surfaces *e* to the receiving apparatus.

In Figure 3, electrically conducting materials *c* are pressed into the ribs *d* of the vehicle roof *b* and are connected together by a conductor f^1 and to the receiving set by a lead *f*.

In Figure 4, electrical conductors *c*, for example wires, are stretched between the existing ribs *d* of the vehicle roof; the aerial lead to the receiving set being again indicated by *f*. For supporting the conductors, recesses, such as bores d^1, may be pressed in the ribs *d* at the time of production, the conductors being drawn through such recesses or bores, as shown. Or the ribs *d* as illustrated in Figure 5, may be provided with pressed-on projections d^{11} to which the wires are attached.

Obviously, the examples illustrated can be multiplied at will and, in particular, a combination of pressed-in, stuck-on and sprayed-on electrically conducting materials may be used to produce an aerial formation.

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Fig. 1.

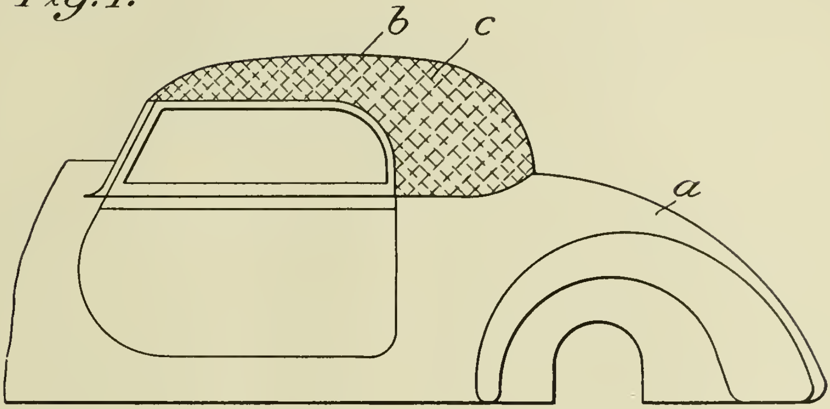


Fig. 2.

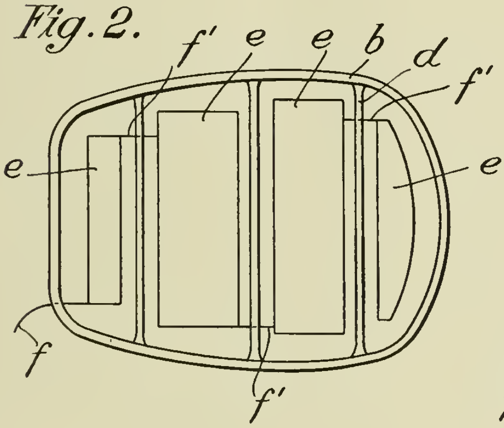


Fig. 4.

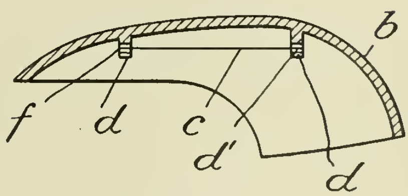


Fig. 3.

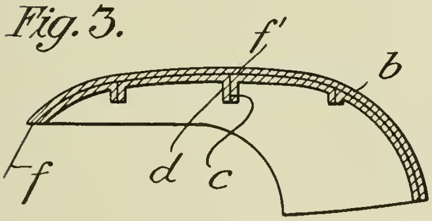
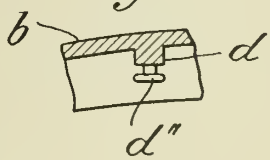


Fig. 5.



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ALIEN PROPERTY CUSTODIAN

PAPER CONTAINER, METHOD FOR TIGHT SEALING A PAPER CONTAINER AND BLANK FOR PAPER CONTAINER

Harry Lehmann, Dusseldorf, Germany; vested in the Alien Property Custodian

Application filed March 7, 1939

The invention relates to a paper container with folded closure as well as a blank for producing such a paper container. The invention furthermore refers to a method for tight sealing the folded closure of a paper container. It is known to provide paper containers with a flat folded closure formed by bellowlike folding of the upper walls. One prefers especially such paper containers, the mouth of which in opened state has a square cross-section and when sealed is folded up ∑<-shaped. It is, however, also known to fold the mouth of paper containers which in opened state is square or polygonal, in such a way that in the flat folded closure several bellowlike folds are arranged side by side.

For protecting the flat folded closures of paper containers, U-shaped clips of metal or similar material are pressed on. By employing these metal clips, considerable costs are caused. One has already, under simultaneous heating over the melting point of the means for impregnation, welded together the flat folded closures of paper containers which have been impregnated with wax, paraffine or similar materials, in order to heat-seal (weld) in this way the single paper layers of the flat folded closure by melting the means for impregnation. In such paper containers on one or two of the walls which form the outside faces of the flat folded closure, projecting flaps are also arranged which after folding down of the closure are folded down against the lower part of same. At the heat-sealed (welded) closures of paper containers as mentioned easily difficulties are experienced, the more since the tension in the paper tends to effect a parting of the welding. After discontinuing the pressing-on pressure, the single heat-sealed paper layers particularly then can easily part from each other, when according to the hitherto working method the means for impregnation which serve as means of binding are heated above their melting points, because the liquefied means for impregnation have only a very slight power of binding.

In a paper container with folded closure—according to the invention—the walls which in a known manner have been folded bellows-like to a flat folded closure, have different heights so that the walls mentioned overlap each other in a step-like manner. Preferably, the in the flat folded closure each other steplike overlapping rims of the walls of the paper container, folded against each other, are folded down immediate above the lowest part of rim and are pressed against the lower flat folded part of the closure. It furthermore corresponds to the invention, in a paper container, the body of which, enlarging to the top, has a length seam, to provide this length seam in that part of the container body which in the flat folded closure projects the other parts of the wall.

The paper containers, formed according to the invention, distinguish themselves by a specially tight and safe closure, because every split existing between two paper layers is closed by the folded adjacent overlapping end. In paper containers which are impregnated with paraffine, wax or the like, the folding closure which follows when employing the invention, is especially well suited to be secured by heat-sealing the means for impregnation. According to further development of the invention the heat-sealing of the closure takes place in such a way that the folded closure is strongly pressed together and at the same time is heated to that temperature that is slightly below the melting point of the means for impregnation. The heating takes place only up to that degree at which the means for impregnation tends to stick to a similar material under the influence of pressure. The complete softening or liquefaction of the means for impregnation is, however, avoided; it is prevented that the melted means for impregnation drop into the container to be sealed and infect the contents. It is furthermore avoided that the folded closure, after releasing the pressure, opens again under the influence of the tension in the paper, since the power of binding of the means for impregnation which have only been slightly heated in the mentioned manner is—contrary to the power of binding of the completely softened means for impregnation—sufficiently strong to resist the tension of the paper.

For the production of paper containers enlarging conically to the top—according to the invention—only such blanks have to be considered in which that rim, which later forms the upper rim of the paper container, is limited by a nearly straight line extending nearly over half of this rim. In a blank of which a paper container enlarging to the top, with a square folded closure when opened, is produced, it is in accordance with the invention that the blank at that rim that later forms the upper rim of the paper container is limited by a nearly straight line which extends at least over 3 sides of the folding closure of the paper container to be produced and being square in open state.

For demonstrating the invention, in the following a paper container, a blank serving for pro-

ducing this paper container and the method for sealing the paper container are described.

Figure 1 illustrates the usual arrangement of the known blanks in the paper web of which they are being cut out,

Figure 2 illustrates the arrangement of blanks according to the invention in a paper web of which they are cut out,

Figure 3 illustrates the upper part of a paper container according to the invention with full opened part of closure,

Figure 4 illustrates the same container with half-closed closure,

Figure 5 illustrates the same paper container with flat folded closure,

Figure 6 illustrates the same paper container after folding the upper rim of the flat folding closure,

Figure 7 illustrates the paper container with pressed and heat-sealed (welded) folding closure,

Figure 8 illustrates in an enlarged scale a section through the closure according to line A—B of Figure 6.

For the production of paper containers with a folded closure which in opened state has a square cross-section and which is folded ∑<-shaped the blanks are cut out of a paper web in a known manner, as illustrated in Figure 1. The points UTWV form on the paper container to be produced the corners of the square-shaped mouth. In the cutting-out mentioned only little waste is caused. The waste caused for a single blank exists only of the three in Figure 1 by dotted lines marked faces *a*, *b*, *c*.

It is in accordance with the invention to form the blanks according to illustration 2. The waste is considerably reduced since the waste caused for a single blank is only according to *a'*, *b'* and c. It is obvious that the waste *a'* and *b'* is considerably smaller than the waste *a* and *b* which results according to Figure 1. The blank is by utilizing the paper, which formerly was scrapped as waste, enlarged to such an extent that it extends over the hitherto existing lines TU and WV respectively, according to the lines TXY and WZY respectively. From such blanks the paper containers are formed which are shown in illustrations **3—8**. Whilst the up to now customary paper containers at the upper rim mostly are limited by the lines TUVW extending parallel to the bottom, the closure part of the paper containers shown in illustrations **3—8** is extended over the mentioned lines TUVW up to the upper limit-line TXYZW. On the line TW the upper rim of the container mouth runs parallel to the bottom; the limit lines TX and WZ rise diagonally; at the 4th side the upper container rim forms a flap XYZ. At this side also the length seam of the container body is provided.

When the folded closure is folded flat, the adjacent paper layers overlap each other step-like which is shown in illustration **5**. The front side ending in the rim TW of the paper container will be overlapped by the adjacent parts of the bellow-like folding, since the rim lines TR and WS extend over the edge TW. These again are overlapped by the rims RX and SZ of the adjacent paper layers over which again the flap XYZ projects which is formed by the rim of the 4th container side. The illustrations **6—8** show that the each other overlapping parts of the folding closure, which extend over the lowest rim line TW, are folded down against the lower part of the flat folded closure. The split adjacent to the front part of the container is covered by the folded rims TR and WS of the adjoining folded parts of the container wall. The next overlapping is formed by the folded rims RX and SZ. The split which is between the last (4th) container wall and the bellow-like folded wall parts is overlapped by the folded flap limited by the rim line XYZ. The position of the folded parts and particularly the step-like overlapping is especially illustrated by Figure 8 from which is to be seen that nowhere one flap to be folded has to cover several splits by which the safe closure of the splits would be undecided.

For security, a clip of metal, Bakelite, Celluloid or any other suitable material can be pressed in a known manner over the folded closure described as above, and the upper part of which is folded. In paper containers which are impregnated with paraffine or the like, the formed closure can also be secured by heat-sealing (welding) the means of impregnation. For this purpose the folded closure is strongly pressed between jaws and at the same time heated to a temperature which is slightly below the melting point of the paraffine. Under the simultaneous influence of pressure and heating, the paraffine becomes pliable so that it fills the slight roughness and unites the paper layers pressed against each other. Preferably, the pressing jaws are formed in a known manner in such a way that, as illustrated in Figure 7, the closure is provided with longitudinal wave-like lines or the like. The heat-sealing mentioned is especially effective in consequence of preforming the paper container in accordance with the invention. The front part of the paper container which ends in the rim TW and the adjacent bellow-like folded wall parts are not only kept together by heat-sealing the inner face of the mentioned front part of the paper container, but also by heat-sealing the folded, in the rim lines TR and WS ending, overlapping parts. In a similar manner the closure is also secured against the tension of the paper and other arising stress by heat-sealing (welding) the further step-like overlapping parts, the rims of which are defined by the rim lines RX, SZ and XYZ.

The methods according to the invention are especially effective when dealing with the paper container, which is folded ∑<-shaped. They may, however, also be employed advantageously in other kinds of folding, for example in such cases in which several bellow-like folds are formed immediately adjoining each other.

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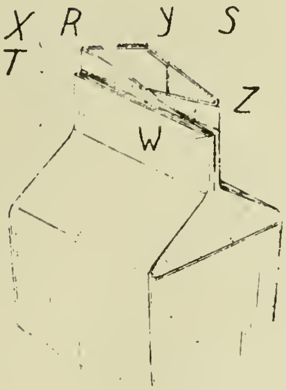

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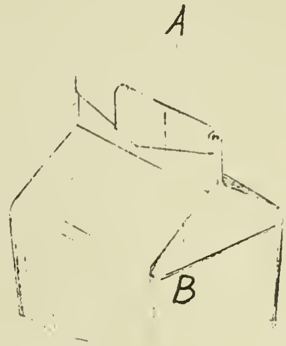

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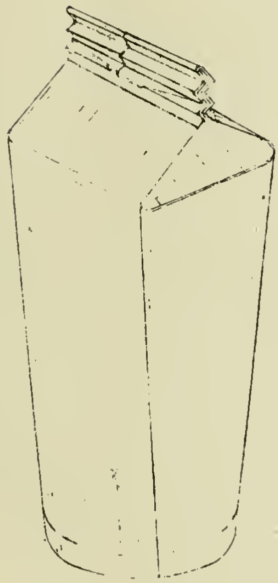

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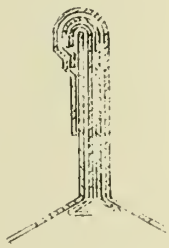

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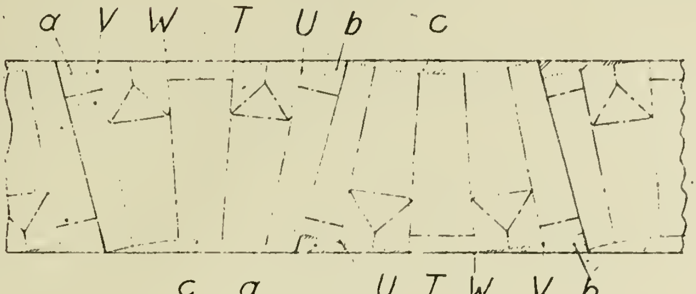
2 Sheets-Sheet 2



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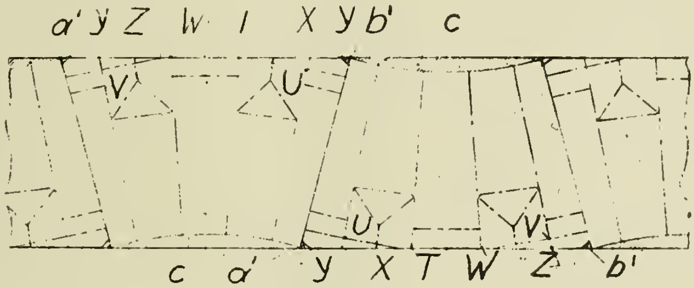

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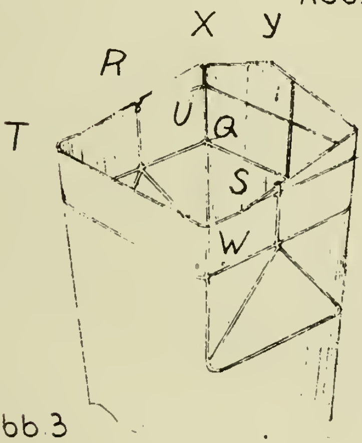

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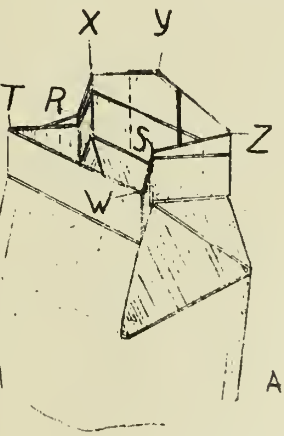

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ALIEN PROPERTY CUSTODIAN

SHOCK ABSORBING MEANS FOR AIRCRAFT LANDING GEAR

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Application filed March 17, 1939

The constant increase in weight and load on aircraft renders the problem of landing more and more difficult. It is obvious that independently of the static charge which it has to resist, the landing gear must support efforts presenting multiple components. But to these various forces must be added a live force all the more considerable as the weight and the speed of aircraft daily increase.

It is therefore necessary to give not only to all the elements of the landing gear a resistance proportionate to the said efforts but also to devise a system of shock absorber for the landing gear which is in relation to the static charge and the important live force which has been referred to.

By reason of the order of the forces set up it is no longer possible to utilise mechanical shock absorbers with springs or "sandows" or even air actuated shock absorbers which are found to be insufficient. That is why aircraft constructors have since several years adopted shock absorbers braked by liquid and commonly known as hydro- or oleo-pneumatic absorbers.

But the already existing arrangements have the inconvenience of presenting either an insufficient stroke or else a cumbersomeness necessitating an abnormal elevation of the fuselage above the ground and difficulties in retracting the landing gear.

The present invention therefore has for object an oleo-pneumatic shock absorbing device for landing gear adapted to resist all the efforts above referred to and designed to absorb the live force of the apparatus in such a manner that the absorption of work resulting from this shock absorption, can occur, on the one hand, independently of the speed of the latter by:

1. The wheel tyres situated at the extremity of the gear legs;

2. the compression of the air in the shock absorbers and on the other hand, in relation to the speed of said shock absorption, by:

3. the slicing off of the liquid passing through a variable section created in each shock absorber between an upper cylinder integral with the landing gear and a lower cylinder integral with the wheel bearing and sliding alongside of the first cylinder which encases it, this section being adjusted in such a manner that the slicing shall be very considerable at landing and very slight in travel.

Conditions 2 and 3 are fully realised by the shock absorbing device provided by the invention and which more particularly has the following characteristics:

One of said characteristics resides in the means used to obtain a variation of the section for the passage of liquid, according to the course, such that it permits of obtaining on landing a given shock absorbing graph preferable of trapezoidal course and, consequently, a progressively of the load transmitted to the supporting planer.

Another feature resides in that the above devised variation in section of the passage of liquid is obtained with aid of a needle valve of known type the section of which can be easily adaptable to any characteristic desired and the position of which on the upper cylinder in the shock absorber permits, for an equal stroke, a much less amount of space occupied than that with shock absorbers of the same type already existing.

One feature of the invention also resides in a plunging tube serving to establish the level of liquid at the filling operation, provided in the upper cylinder and which allows, owing to its easy dismantling and its interchangeability, to modify the ratio of air compression on which the smoothness of running depends.

A feature also resides in the complete filling with liquid in the forward travel, of a kind of return pump, consisting of an air cylinder and its lower end on the one hand, and a piston, with valve, integral with the lower cylinder, on the other hand, and connecting the return to the discharge of liquid in the lower cylinder through an adjustable passage formed in the lower bottom of the air cylinder, this filling thus eliminating any vacuum in the pump which is a cause of hardness of the shock absorber at the forward movement and of a rapid return (rebound).

A feature in addition resides in the arrangement of the regulating member of the section for the passage of said liquid which permits of the easy access of said organ from the outside at any moment and in any place without necessitating any dismantling, the delivery of return liquid from the upper cylinder to the lower cylinder being thus easily brought to a value such that any rebound is suppressed and this facility of adjustment rendering it always possible to adapt the characteristics of the shock absorber to those of aircraft type under consideration.

Another feature resides finally in that the communication between the lower cylinder and the air cylinder, with reference to the return speed, in all positions is important, ensuring in

this way the complete return to the lower cylinder of the small complement of oil not delivered by the return pump and eliminating in this manner in this cylinder any vacuum which would be a cause of shock at the next following forward stroke.

Various other particularities will on the other hand, be brought into evidence from the following description with reference to the accompanying drawing showing in:

Fig. 1, one of the limbs of the landing gear shown in longitudinal section;

Fig. 2, a section to a larger scale of the main part of a shock absorber;

Figs. 3 and 4 comparative diagrams of the space occupied by the shock absorber constructed according to the invention and that of an existing shock absorber;

Fig. 5, the landing gear seen in plan view;

Fig. 6, the diagram or graph of the shock absorber.

In one form of embodiment of the object of the invention, the shock absorber is partly housed in casings **1**, **1′** (Fig. 1) provided in form of a fork in each of the limbs of the landing set.

The landing set is articulated by means of bearings **3** on the driving spindle and receives in a bearing **4** the shaft of the wind bracing.

Each shock absorber comprises a lower cylinder **5** terminated, at its base, by a bearing **6** for the wheel axle and sliding in a lower bearing **7** and in an upper bearing **8** disposed in the casing **1**.

At the end of the forward stroke the wheel bearing **6** abuts at the end of the casing against the lower bearing **8**.

On the upper end **9** of the casing **1** is mounted with a ball joint a cylinder **10** engaging in the previously mentioned lower cylinder **5**.

The upper end **9** is traversed by a depending level indicating tube **11**, accessible and dismantleable from the outside of the casing by reason of a screw plug **12** which carries it.

At its other extremity the cylinder **10** (Figs. 1 and 2) is provided with a lower bottom **13**, which can be dismantled and is provided with a tight sleege **14** tightened onto it by a washer **15** and a nut **16** of a shape such that it forms a means for guiding the upper cylinder **10** in the lower cylinder **5**.

The lower bottom **13** is traversed by a hollow brace **17** secured at one of its extremities, on the wheel bearing **6** and carrying at its other extremity a piston **18** with valve **19** moving in the cylinder **10**.

The piston **18** is provided with openings **20** and **21** adapted to allow the passage of the liquid which is to be contained in the two cylinders **5** and **10**. The cross member **17** has at its base, openings **22** formed for the same purpose. All these openings must have a very large section of passage from one cylinder to the other.

At the inside of the cylinder **10** is secured a mandrel **23** carrying a needle valve **24** of variable diameter in its length and readily interchangeable. The play between the section of this needle and the bore **20** of the movable piston **13** determines the section of variable passage according to the stroke of this latter.

A small channel **25** is bored in the end **13** and more or less obturated at will by a plug **26** accessible from the outside of the casing **1** through a door **27** and after unscrewing a tight cover **28**.

It will immediately be seen that such a device has a very great advantage over oleo-pneumatic apparatus already in existence; that of offering a much smaller encumberment for an equivalent stroke.

If one considers, in fact, a shock absorber of known type (Fig. 3) comprising a needle **24** integral with the lower cylinder **5** a flue **17′** must be provided at least of the same length as the stroke and as the level of the liquid in the upper cylinder **10** must at no moment descend below the valve situated at the upper part of the flue, it will be seen that the dead space *a* being always reserved, the total length of the absorber must include a first space *c′* corresponding to the cylinder space and twice the stroke *c*.

The shock absorber according to the invention comprises, as is seen in Fig. 4, only once the stroke instead of twice and gives, for this reason, a gain in total height of the absorber, all other conditions being equal.

The operation of the shock absorber is as follows:

At the moment of landing the cylinder **5** plunges into the casing **1** and the piston **18** slides inside the cylinder **10**; during this forward stroke the valve **19** offers a large section for the passage of liquid for the complete filling, under the pressure of the air, of the pump for the return created between the lower end **13** of the air cylinder **10** and the movable piston **18**.

It will thus be seen that during the forward stroke, no vacuum, cause of a rapid return and a rebound over all or part of the return stroke, can occur. In fact, at the start of the return stroke the valve **19** closes automatically and the imprisoned liquid is then no longer discharged for the major part, into the lower cylinder except through the passage of adjustable section **25**, whereas the play between the piston **18** and the needle **24** offers, through the intermediary of the hollow cross member **17**, a large return passage to ensure the complete filling of the lower cylinder.

The return of the movable equipment takes place therefore slowly and it is thus impossible for a vacuum, cause of shock in the consecutive forward stroke, to be produced in the lower cylinder **3**.

The speed of this return can be easily modified at any place and at any moment without any dismantling by simply acting on the plug **26** after having placed the fork on a jack and brought the shock absorber to abut against the return abutment (position of Fig. 1 and 2).

This faculty of adjustment permits by the above simple movement to adapt the features of the shock absorber to all types of aircraft.

The ratio of compression can likewise be adjusted very easily by modifying the length of the plunger tube **11** directly dismantleable with the plug **12** accessible from the outside.

On the length of the tube **11** depends in fact the quantity of liquid introduced in the cylinders and from its selection there results therefore a more or less smooth running.

In order to ensure that the ratio of compression shall be identical in the shock absorbers of both limbs **1** and **1′** (Fig. 5) of the half carriage, the plunger tubes **11** of the two absorbers are interconnected by piping **29** passing through a device **30** which permits of the filling and inflation of the shock absorbers.

The variation of the section for the passage of liquid by the openings **20** and **21** can be modified at will by the adoption of a needle **24** of appropriate shape and which, being removable, can be

replaced by any other needle adapted to the characteristics desired.

This variation in section of the passage for the liquid according to the stroke permits of obtaining, for example, on landing, a trapezoidal shock absorbing diagram and thereby progressiveness of the load transmitted to the wing surface. This diagram is represented at Fig. 6 and shows the advantage of the device of the invention over absorbers with constant section.

On this diagram the curve I relates to the variation of the load according to the isotherm, for a slow compression and for the case of running on the ground, the static equilibrium of the load being at half stroke.

The curve II corresponds to the compression of the air according to the adiabatic at the moment of landing.

The curve III (casing: air+liquid) determines the total surface of the diagram of work to be absorbed by the shock absorber in terms of the height of fall at landing.

Curve IV corresponds to the variation of the speed of shock absorption, deduced from the curve III. The surface comprised between the curves II and III delimits the slicing work of the liquid, transformed into heat.

Curve V represents the over-pressure in kg/cm² in the lower cylinder 5 with regard to the air cylinder 10, deduced from the difference, at all points, between the curves III and II.

Curve VI represents the section of passage of the liquid, corresponding to the curve III (total absorbed work) through the medium of curves V, IV and II.

VII represents the graph of a shock absorbing for a hydro-pneumatic absorber comprising hydraulic braking by slicing or lamination of the liquid through a constant section. The surfaces delaminated by the curves III and VII are identical.

It is obvious that modifications in shape and detail can be embodied in the shock absorber described hereinbefore by way of example in no way limitative and that without exceeding the scope of the invention.

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4 Sheets-Sheet 1

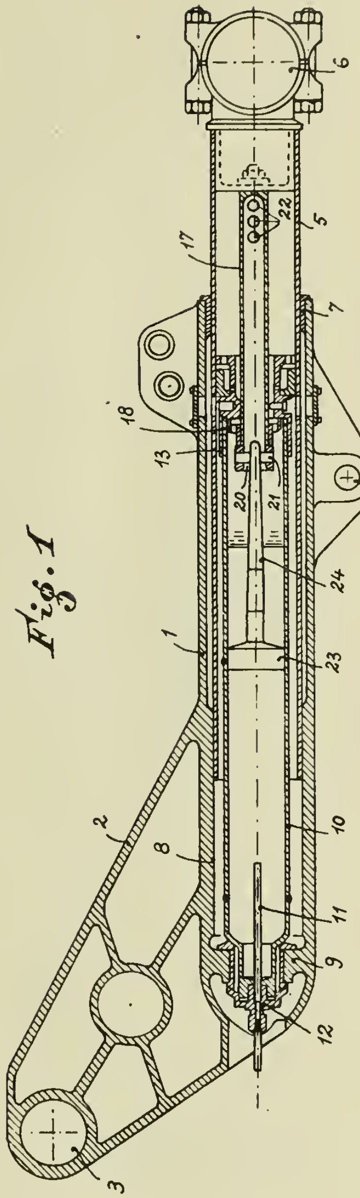

Fig. 1

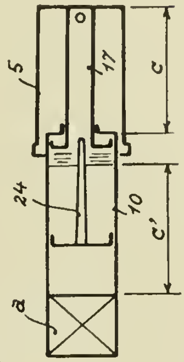

Fig. 4

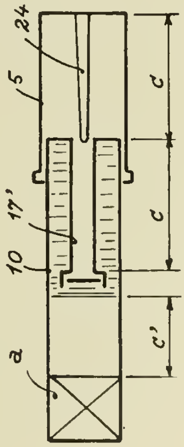

Fig. 3

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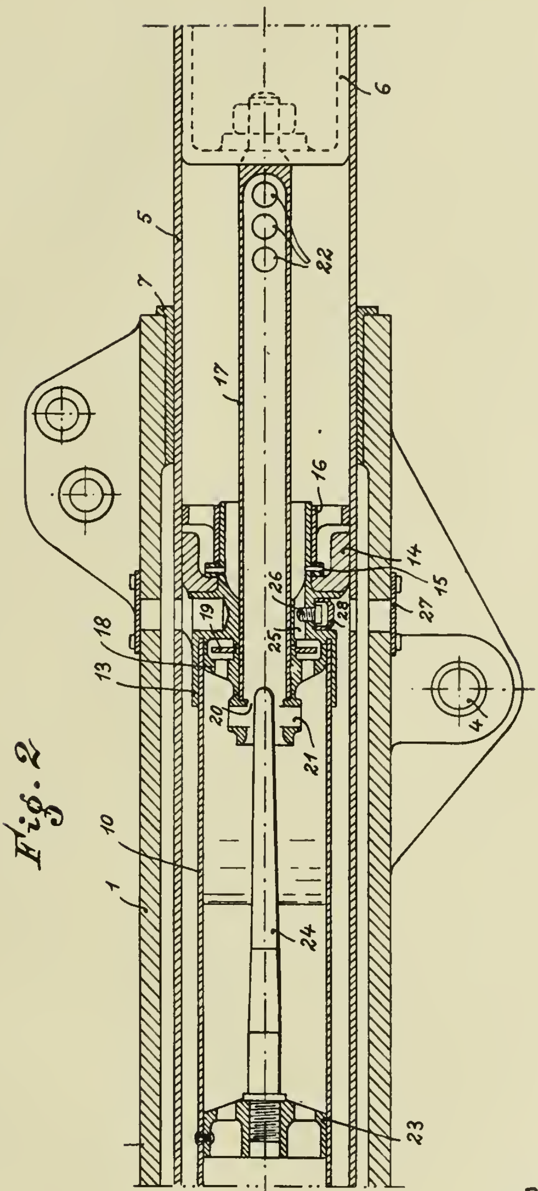

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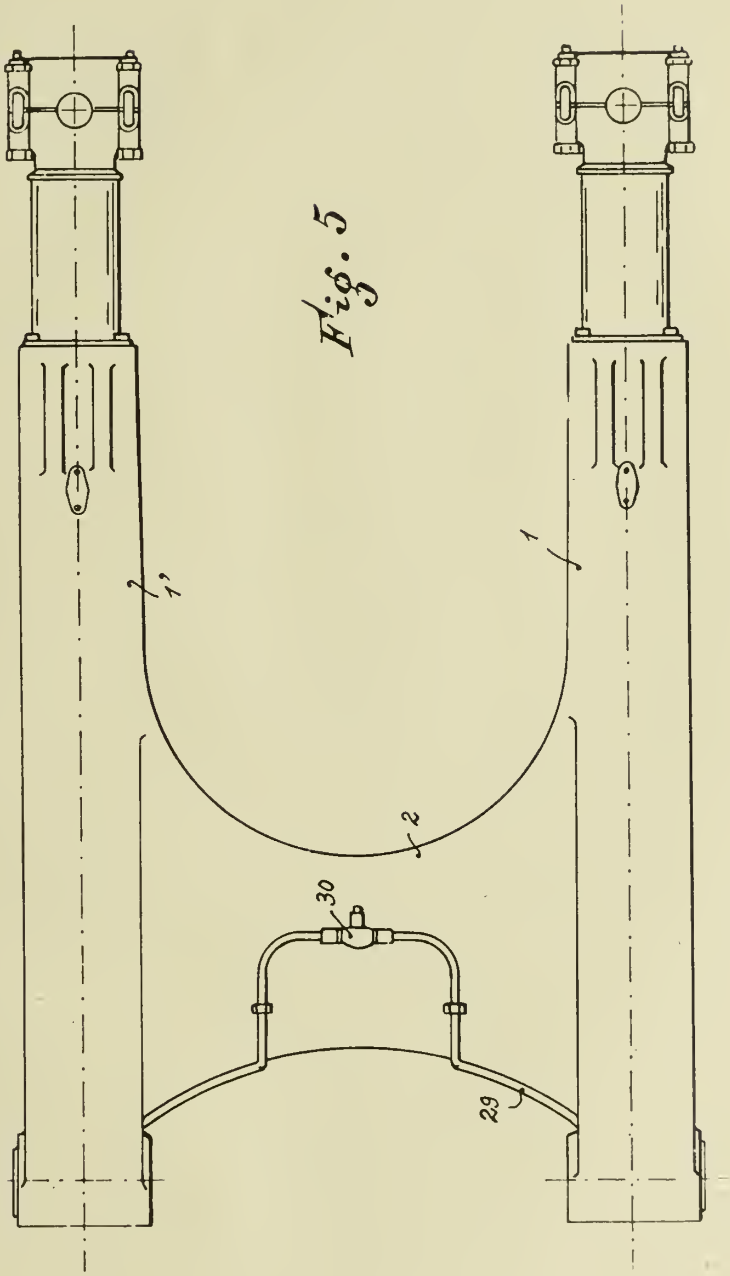
4 Sheets-Sheet 3



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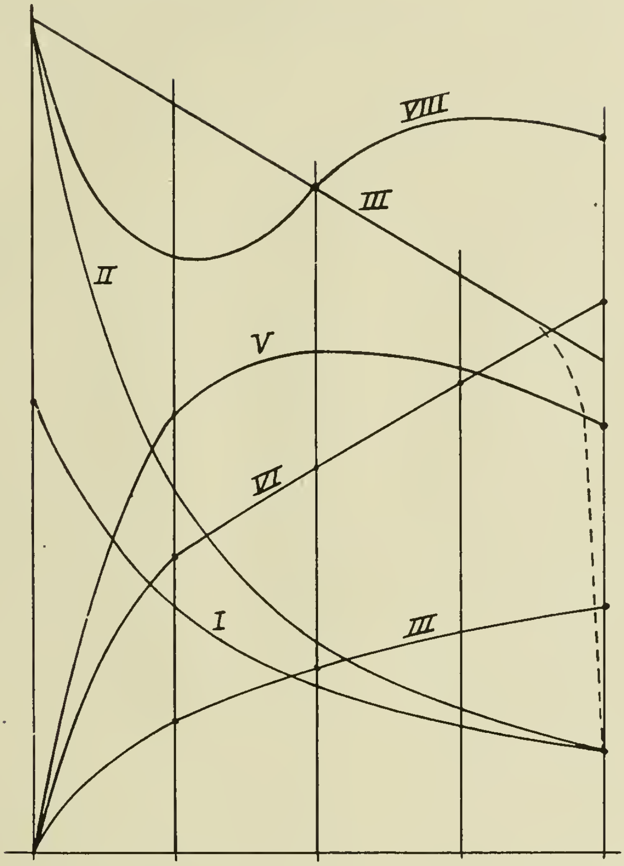

Fig. 6

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ALIEN PROPERTY CUSTODIAN

CALCULATING MACHINES

Angelo Raimondi, Milan, Italy; vested in the Alien Property Custodian

Application filed March 17, 1939

This invention relates to improvements in calculating machines, and has for its object to improve their operation, to simplifying their construction and to increase their life.

The principal feature according to the invention consists in that the controlling gear combined with each row of keys is actuated by means of a pinion provided with teeth which are freely movable in a direction parallel to the axis of the controlling shaft, the movement of a selected tooth to operating position being obtained by operating the corresponding key.

A further feature consists in this that, with each row of keys, means are combined which are adapted to be displaced axially, on depressing any of the keys, the mechanism transmitting the motion from each key to the aforesaid means being so designed so as to take into account the distance of each key from the position of connection of said means with the members controlled by them and controlling, in their turn, the movement of the movable teeth of the pinion.

A further feature of the invention consists in that the pinion provided with the movable teeth is formed by two disks having notches therein for accommodating the members forming the movable teeth, so that said members, which are retained in the rest position by resilient means, can be selectively moved axially by the controlling means actuated by the said keys.

A still further feature of the invention consists in that the means which are displaced axially and which are associated with each row of keys, consists of carriage bars provided with pins subject to the action of inclined projections formed integral with said keys, said bars being adapted to move a cam provided on a pivoted lever into the circular path on or a number of countercams which are arranged laterally of the movable teeth of the pinion, so that, according to the angular position of the cam on the pivoted lever and of the length and radial position of the counter-cams, the selected movable teeth are moved sideways, rotating at the same time, so as to cause the desired angular rotation of the dials of the counting and registering mechanism.

Reference will now be made to the accompanying drawings, which illustrate by way of example, a constructional form of one of the embodiments of the calculating machine according to the invention in which:

Figure 1 is a cross section along line **1—1** of Figure 2;

Figure 2 is a partial top view, with cover off, the selecting members being shown, conventionally, in cylindrical projection developed in a plane,

Figure 3 is a partial cross-section along line **3—3** of Figure 2;

Figure 4 is a section of a selecting pinion along line **4—4** of Figure 1, and

Figure 5 shows the different shapes of movable teeth belonging to each single selecting pinion.

With reference to Figures 1 and 2, A is the key-board, B are the groups of selecting pinions, and C is the carriage accommodating the digit drums for indicating and registering the various operations. The carriage can be shifted in different positions; namely C^1 are the total or product drums and C^2 are the drums adapted to indicate counting or quotient. The said carriage is provided with means for returning the drums C^1 and C^2 back to zero. The key-board A is provided with a number of rows of keys, each row having 10 keys of which key **1^1** is the column corrector.

The keys are carried on stems **2**, which are influenced by return springs **3**. Said stems are provided with notches **4**, into which can be inserted the edge of a lever **5**, which is pivoted at **6** and serves the purpose of maintaining a single key in the depressed position, and at the same time releasing the other keys of the same row, which have already been depressed.

The release of the depressed keys, can be obtained either partially per row, by depressing key **1^1**, acting directly on lever **5** of the respective row, in which case the key need not be kept in the depressed position, or for all rows at the same time, by means of a general correcting key, (not shown) acting simultaneously on the levers **5** of each row, the latter being suitably connected to each other.

The lower end of each stem **2** carries two projections **7** each of which is provided with an inclined portion capable of acting on pins **8** and **8^a**, fixed on carriage bars **9** and **9^a** respectively, the latter being arranged in pairs for each row of keys. The pins **8** and **8^a** are suitably kept apart by the inclined edges of the projections **7**, so that, on depressing a key, a corresponding movement of the bars **9** and **9^a** is obtained. The bars are designed so as to slide in guides, and their amount of movement will be proportional to the succession of the digits, as will be disclosed hereafter.

Said bars are under the action of return springs **10**.

The upper end of each bar (see Figure 1) is

adapted to engage with an arm 11 of a lever 12 which is pivoted at 13, whilst the other arm of said lever is shaped at its end 14, in form of a cam, so as to act on the movable teeth in a manner hereafter described.

The selector group B (see Figures 1, 2, 3 and 4) comprises a number of pinions, each formed by two disks or flanges 15 and 15^a; keyed to a controlling shaft and kept apart by suitable distance pieces. The number of pinion, forming the group of selectors, may vary according to the numbers of rows of keys and therefore according to the capacity of the machine.

The disks are provided with radial notches or cuts; namely disk 15 is provided with five notches 16 and disk 15*a* has instead only four notches, said notches being all at equal angular distances one from another.

Disk 15^a of each pinion (except on the first selector I of the "units") is provided with two additional notches 17, of a different depth than the former notches 16, placed respectively before, and after notches 16, and at an angular distance which is a multiple of the single spaces between the notches 16, namely, disk 15^a of the IInd selector (selector of "tens") has the notches 17 angularly displaced a distance equal to two single spaces relatively to the last notch 16, of disk 15 or 15^a. In the IIIrd selector (selector of "hundreds") the notches 17 are angularly displaced a distance equal to three single spaces and so on, for the further selectors.

Furthermore the disk 15^a is provided with two cam-like projections 18, placed near the periphery of said disk and in proximity of notches 17: said projections being all equally spaced from said notches 17. Within the notches 16 and 17 are placed movable teeth 19, 20, 21 . . . 29 (see Figure 5) provided with guiding wings 30, engaging in the corresponding pairs of holes 31 in the flanges, so that the movable teeth are free to move in a direction parallel to the axis of the controlling shaft. Each tooth is influenced by a spring 32 retaining it in the rest position.

The movable teeth are also provided with counter-cams or actuating feet 33 of varying height; for instance teeth 20 and 21 arranged in the slots 16 of flange 15^a are higher than the counter-cams 33 of the following pair of teeth 22 and 23. In slots 16 of the other flange 15 are arranged slide teeth 24 maximum height, then follow the three teeth 25, 26, 27 all of same height, having the counter-cams 33 lower than those preceding and finally tooth 28 with counter-cam 33 of least height.

These movable teeth have also, in their upper part, projections or noses 34, which are adapted to mesh with the teeth of a gear-wheel 35, arranged on the centre-line of the pinion, said gear wheel in turn being adapted to drive a gear wheel of the totals indicator C^1.

In the same way the movable teeth for the carry-over 19 and 29, are provided with their own counter-cams 33, suitably staggered towards the outside, so as not to interfere with cam 14 of lever 12.

The teeth in the carry-overs 19 and 29, of each pinion, are actuated by a lever 36 having two angular positions, said lever being provided with a cam 37, which is brought to act upon one or the other of said teeth by means of a projection or tooth 38, (according to the arithmetical operation to be performed). Said tooth is actuated by means of a pin placed on the wheel of every single drum of totals C^1; that is, a drum C^1 having made a complete revolution, causes the operation of lever 36, and thus advances one of the teeth 19 or 29 of the selector following drum C^1, which drum has caused the operation of said lever. Lever 36 is restored to its initial position, or position of rest, by the cams 18, after having operated the carry-over.

The series of the digit drums of the indicating-counters or of the quotients C^2 are operated in a known manner by a resilient ratchet controlled by an eccentric not shown keyed on a shaft 39, on which the group of selectors B is fixed. Thus, at each revolution of the group of selectors B, the drum C^2 will move a step forwards or backwards according to the operation fulfilled. Preferably with this object in view, the drums have 19 teeth which correspond the step by step sequence of digits in increasing and in decreasing order, namely from zero to nine; and from nine back to zero. These two series of digits are painted a different colour so as to show at a glance whether the operation made is a positive (sum, multiplication, etc.) or negative (subtraction, quotient, etc.).

The shaft 39 carrying the selectors B is rotated in bearings arranged in the frame of the machine and at one end is keyed a gear wheel 40, to which motion is imparted, either directly, or through other gears 40^a, from a crank 41, or alternatively from an electric motor arranged inside the frame.

The group of selectors B, as stated above, can rotate in both directions, for achieving either negative or positive operations and is further provided with suitable locking systems, for the purpose of preventing mishandling.

The operation of the machine is as follows:

On depressing any one of the keys 1, one or the other or both bars 9 will be moved. Said bars actuate the levers 12 coupled to each bar, so that their cams 14 will move through an angle proportional to the number depressed. The cams will therefore move into the path (circumference) of the counter-cams 33 relative thereto, and on rotation of the groups of selectors B, the counter-cams 33 will be moved by cams 14 towards the centre of the pinion. Thus the projections 34 will engage with the teeth of wheel 35 (see Figure 4) and the latter will be rotated by a number of teeth equal to the number of movable teeth with which they engage. This number will be registered by the digit drum C^1, of the total, whilst the number of revolutions of the selector group B, will be registered by the numeral digit drums C^2.

Let us now consider one of any of the rows of keys in the keyboard: the formation of the numbers is obtained as follows: (the same process being followed for the other rows of keys).

Number one

Key 1 is depressed and bar 9 at the left (Figure 2) moves its corresponding cam 14 to the first position. On rotation of the selector group B, the movable tooth 24 will be moved sideways to mesh with wheel 35, thus moving on drum C^1 by one step.

Number two

The corresponding key is depressed and bar 9 at the right moves its cam 14 corresponding to the first position and, on rotation of the selector group B, teeth 20 and 21 will engage the wheel 35 and as stated above move the drum C^1.

Number three

The corresponding key on being depressed, acts on both right hand and left hand cams **14** moving them both to the first position. Teeth **20**, **21** and **24** will be moved into engagement of wheel **35**.

Number four

Only the right hand cam **14** is moved to second position, thus moving into engagement teeth **20**, **21**, **22** and **23**. It is however possible to combine this number by acting on the left hand cam **14**. moving it to the second position, and thus moving teeth **24**, **25**, **26** and **27**.

Number five

The left hand cam **14** is moved to the third position, thus acting on teeth **24**, **25**, **26**, **27** and **28**. As in the preceding case, number 5 can be combined likewise by moving the right hand cam **14** to the second position and the left hand cam **14** to the first position; thus teeth **20**, **21**, **22**, **23** and **24** will be moved.

Number six

The left hand cam **14** is moved to the second position, the right hand cam **14** moving to the first; thus teeth **20**, **21**, **24**, **25**, **26** and **27** will be moved.

Number seven

The left hand cam **14** is moved to the third position and the right hand cam to the second, thus moving teeth **20**, **21**, **24**, **25**, **26**, **27** and **28**.

Number eight

Both cams **14** are moved to the second position thus moving teeth **20**, **21** . . . **26** and **27**.

Number nine

The left hand cam **14** is moved to the third position and the right hand one to the second, thus moving sideways all nine teeth.

The carry-over levers **36**, move the carry-over teeth **19** and **29** in the manner previously described and therefore at every complete revolution of any drum C^1, the following drum will be advanced by one unit, whilst cams **18** will return the levers **36** to their original position.

The arrangement of the movable teeth, as specified and illustrated, is designed with a view to obtaining a better stress repartition both on the keys and on shaft **39**, thus causing an almost uniform wear of the operating members.

It is to be understood that other arrangements of the movable teeth might be designed, as for instance by arranging them all on one side of flanges **15** or **15**^{a}, or else by placing six teeth on one side and three on the other, either in immediate sequence or alternating, and so on.

Alternatively, the movable teeth could be made so as to obtain an angular displacement instead of a rectilinear shift. In this case it would be sufficient for instance to fulcrum the lower end of said teeth on the ring placed between the flanges **15** and **15**^{a}.

It is also to be understood that these and other details of design and construction may be varied without thereby departing from the nature of the invention.

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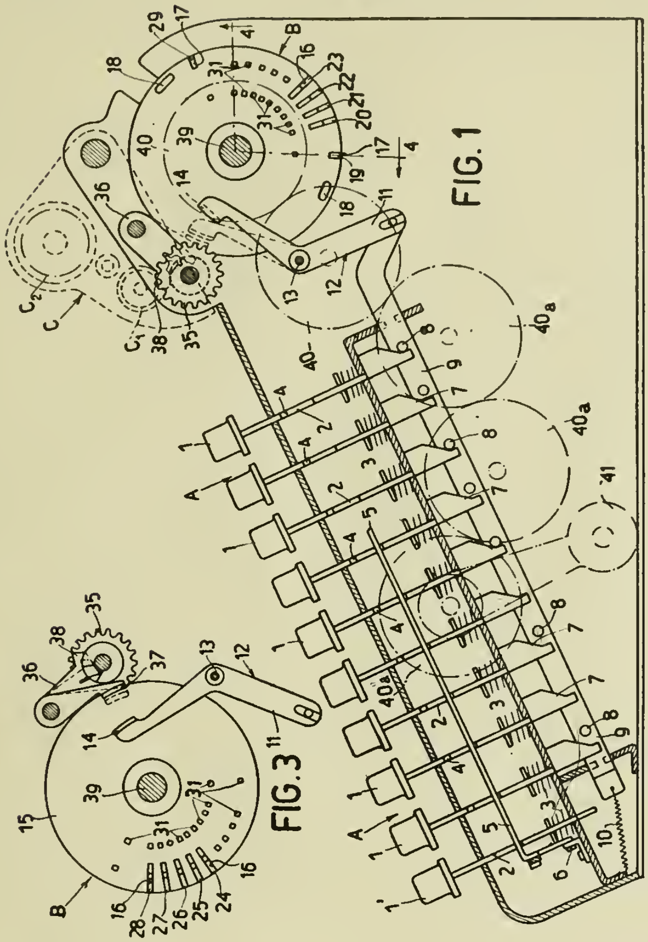

FIG. 1

FIG. 3

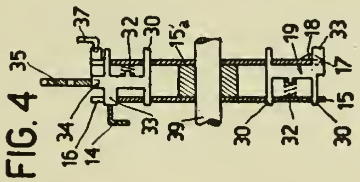

FIG. 4

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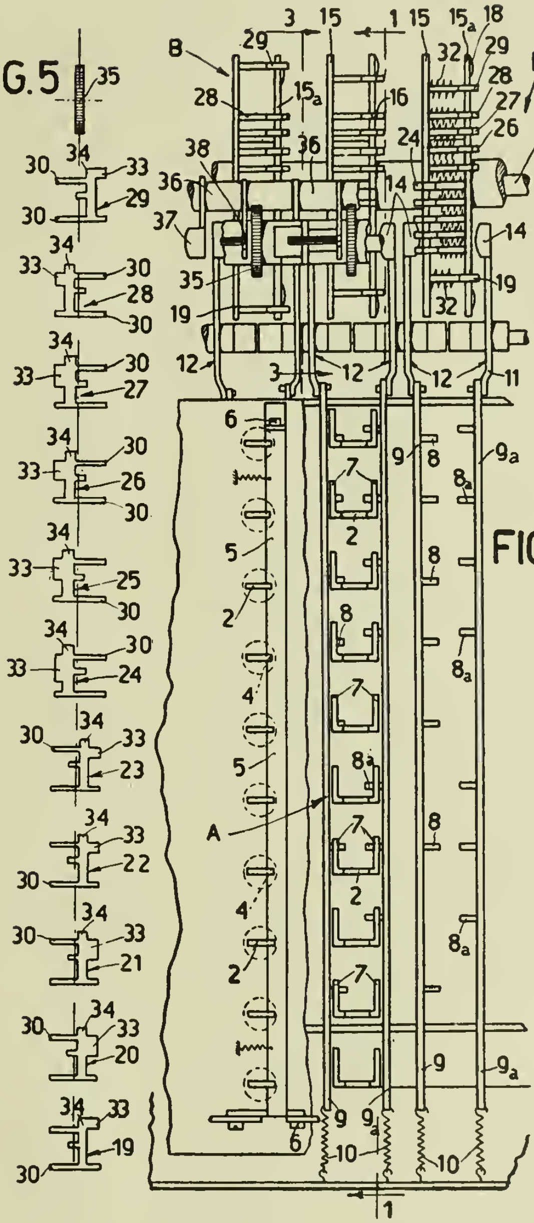
FIG. 5

FIG. 2



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